SOME DETERMINANTS OF PROFITABILITY : A STUDY IN THE STRUCTURE–CONDUCT–PERFORMANCE FRAMEWORK OF THE INDIAN PHARMACEUTICAL INDUSTRY

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DOCTOR OF PHILOSOPHY

By

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to the

DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
INDIAN INSTITUTE OF TECHNOLOGY, KANPUR
November, 1988

CERTIFICATE

This is to certify that the thesis "SOME DETERMINANTS OF PROFITABILITY : A STUDY IN THE STRUCTURE-CONDUCT-PERFORMANCE FRAMEWORK OF THE INDIAN PHARMACEUTICAL INDUSTRY" submitted by Mr. Mohan Nagarajan in partial fulfilment of the degree of Doctor of Philosophy to the Indian Institute of Technology, Kanpur is a record of bonafide research work carried out under my supervision and guidance. The results embodied in the thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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This is to certify that Mr. Mohan Nagarajan has satisfactorily completed all the course requirements for the Ph.D. programme in Economics. The courses include :

ECO	732	ECONOMETRICS
ECO	733	THEORY OF ECONOMIC POLICY
ECO	736	INDUSTRIAL ORGANISATION AND POLICY
ECO	737	DEVELOPMENT ECONOMICS
ECO	739	PRICE THEORY
ECO	741	PROJECT ECONOMICS

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SYNOPSIS

SOME DETERMINANTS OF PROFITABILITY : A STUDY IN THE STRUCTURE-CONDUCT-PERFORMANCE FRAMEWORK OF THE INDIAN PHARMACEUTICAL INDUSTRY.

- A thesis submitted in partial fulfilment of the requirements for the Degree of Doctor of Philosophy by Mohan Nagarajan to the Department of Humanities and Social Sciences, Indian Institute of Technology, Kanpur, November, 1988.

The pharmaceutical industry in India has developed rapidly in the last four decades. Initially comprising of firms which were mainly trading concerns, the industry today has more than 5000 manufacturing units with an investment of nearly Rs.5000 million. Some 130 of these units are in the organized sector while the rest are small units. The industry today is a representative monopolistic industry. There exist firms of all sizes in this industry and competition takes mainly a non-price form. Firms in the industry have undergone some recent changes in structure and most of them now undertake integrated production operations. Some are also diversified within the same two-digit industry. A unique feature of this industry is the prevalence of tight controls over drugs and pharmaceuticals prices and also over the profitability from their sale. It is well known that factors local to the firm and certain external conditions together determine the profitability of a firm. Keeping this in view this study poses the following questions

(a) How important was the structure of the firm in determining its profitability?

(b) What was the effect of changes in particular structural dimensions on the profitability of the firm?

(c) What was the relative importance of price controls vis-a-vis the structure of the firm in determining profitability?

The objective of this study is to find the answers to these questions by examining the relationship between the profitability of the firm and six important determinants, viz.,size of the firm, the degree of diversification, the degree of vertical integration, advertising intensity, growth of the firm and the prices of drugs and pharmaceuticals. A group of 38 firms forms the sample of the study. A single equation regression framework is adopted as the method of analysis. While profitability is measured by the rate of return on sales turnover and the return on total assets, diversification and vertical integration are measured by the Berry's index and the value-added to sales ratio respectively. Growth is measured by the simple growth rates in sales and total assets while the wholesale price index of drugs and pharmaceuticals is used as a proxy for their prices. The study is undertaken initially by regressing profitability on each determinant considered using separate models. Thus we have simple hypothesis for testing like profitability of the firm is a function

of its size; profitability is a function of diversification and so on. The emphasis here is on using time-series data to study the effect of a change in a particular dimension of the firm on its profitability. A preliminary cross-section analysis is also conducted. At the end of this analysis a full model is proposed in which the profitability of the firm is determined by its size, degree of diversification, degree of vertical integration, advertising intensity and growth. Pharmaceutical prices are left out as the price index would be common to all firms. This part is a cross-section analysis. The methodology adopted is expected to provide us a comprehensive answer to the questions posed in the study. Earlier studies of a similar nature on this industry had adopted a piecemeal approach. Ramachandran [1980] investigated the relationship between profitability and size alone while Narayana [1984] only did an indepth analysis of the effect of price controls on profitability. Both studies failed to include other firm-level structural determinants of profitability which is required for a complete analysis. Most recently, Ravenscraft [1983] demonstrated the importance of diversification, vertical integration and advertising intensity in determining profitability which this study incorporates.

The major findings of the study are summarized as follows :

(a) Profitability has no consistent relationship with size. The time-series analysis showed that in individual cases the functional form of the relationship between profitability and size could differ and take either a linear, a semi-logarithmic or a quadratic form. The functional form could also change depending on the measure of profitability or size used. The result is that although size appears important in a number of individual cases, it is not seen to be a significant variable in the cross-section analyses.

(b) Diversification in general was not an important determinant of profitability though in some individual cases it appeared to be so. An analysis of these cases leads to the opinion that the importance of diversification as a determinant depends not on how well-diversified the firm is but on how successful it is in its various undertakings. Generally, however, it is felt diversification may have been undertaken for defensive reasons, only to protect the erosion in profitability.

(c) Vertical integration is found to be strongly and positively related to profitability and emerges a significant determinant although further analysis showed that there might have been some over-estimation of its importance.

(d) Advertising is not found to be anticompetitive as there existed no statistically significant relationship between

profitability and advertising intensity. In certain individual cases, however, it is felt that cost savings resulting from increasing returns to advertising expenditure might have improved profit margins.

(e) The cross-section analysis could not detect any significant relationship between profitability and growth. In many individual cases, however, growth is found to have a positive effect on profitability. The situation could best be termed as a 'win' or 'no-loss' situation with growth having no determental effect on profitability.

(f) Price controls were found to be an important determinant of profitability. In many cases it was noticed that profitability on sales declined despite an increase in the selling prices of drugs and pharmaceuticals as measured by the price index. Subsequently it was found that the increase in selling prices had not compensated increases in the cost of inputs and the profit margins were therefore affected. However, the return on assets was not always affected. This it was felt was due of the ability of the firms in question to shift demand to compensate the reduced profit margins.

These were the results of the preliminary analysis using simple models. The results obtained by applying the full model broadly agree with these results. Size, diversification and advertising intensity were not found to be important whereas vertical integration again emerged as the most significant

determinant of profitability. Growth in sales was also found to be statistically significant though quantitatively its effect was small.

The main conclusion that emerges from the study is that, in general, firm-level determinants with the exception of vertical integration play only a small role in determining the profitability of firms in this industry. This condition may be traced directly to the presence of price and profit controls. Even as price controls have become important in determining profitability they have relegated other factors to the background. Given this situation the best course open to firms to maintain their profit margins, as our study shows, is to undertake a greater degree of internalization. But with ceilings on profitability there may be limited incentives to improve efficiency. In the long run this may result in a high cost industry defeating the very essence of price controls. What is recommended therefore is a dilution of controls on the industry so that firm-level determinants play a greater role in determining profitability. This would lead to greater efficiency in organizing production the benefits of which would then be available to the consumer.

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CHAPTER 1

INTRODUCTION

1.1 HISTORY AND CURRENT STATUS OF THE INDIAN PHARMACEUTICAL INDUSTRY

The Indian pharmaceutical industry can be stated to have originated in the early part of this century when Acharya P. C. Ray established the first Indian owned drug factory , The Bengal Chemical and Pharmaceutical Works, on the outskirts of Calcutta in 1901. This was later followed by the Alembic Chemical Works established in 1907 in Baroda. The period between 1904 and 1907 also saw the establishment of several state-run enterprises such as the Haffkine Institute in Bombay, the King Institute of Preventive Medicine in Madras, the Pasteur Institute in Conoor and the Central Research Institute in Kasauli. These institutes were set up by British medical scientists for studying tropical infectious diseases which were taking a heavy toll of the then British Indian army [Ramachandran and Rangarao, 1972].

The coming of World War I and the resultant shortage of imported medicaments helped the domestic industry take up the production of a number of drugs such as Quinine, Caffeine, and Urea-Stibamine on a substantial scale. But the period after the war saw the resumption of cheaper imports which served as

a setback to the local industry and therefore India continued to be dependent on England for its needs. Although the local industry grew steadily and even took up the manufacture of biological products like sera and vaccines, Indian produce formed only about 13% of its medical requirements during this period [Narayana 1984]. However, the shortage of imported medicaments arising from World War II encouraged a number of small local manufacturers produce simple preparations such as normal saline, distilled water and other simple formulations which found a ready market. World War II can be called a water-shed in the development of the Indian pharmaceutical industry after which its development accelerated considerably. With the coming of independence in 1947, the industry received a boost when a number of foreign pharmaceutical firms started trading operations. Some even set up manufacturing facilities to produce formulations from imported bulk drugs. By 1947, the estimated value of production of medicaments had grown to Rs. 10 crores[1] [Narayana 1984]. In the next few decades, the industry witnessed rapid growth. Whilst the number of firms increased, the existing firms grew in size and many even came under the purview of laws such as the Monopolies and Restrictive Trade Practices Act which restricted unfettered growth. By 1979-80, there were 5,156 units producing drugs and pharmaceuticals with an estimated investment of Rs.500 crores. Out of these, about 130 units were in the organized sector while

1. 1 crore = 10 million

the rest were small units. These figures also include two large public sector units owned by the central government, viz. Indian Drugs and Pharmaceuticals Limited and Hindusthan Antibiotics Limited. Smaller units have also been opened by a few state governments. The pharmaceutical units in the country can be broadly classified under three categories which are foreign owned, Indian private and the public sector respectively. In 1979-80, the foreign, Indian private and public sectors accounted for 43%, 24%, and 33% of the aggregate investments.

The range of pharmaceutical products produced has increased dramatically over the years, covering some thirty-eight product categories such as antibiotics, sulpha drugs, vitamins, analgesics and antipyretics, cortico-steroids, anti-T.B. drugs and so on. In 1981-82, the total production of bulk drugs and formulations was estimated to have touched Rs.289 crores and Rs.1,430 crores respectively. Today, the industry produces enough to make the country self-sufficient in many essential drugs. It also undertakes exports to other countries.

1.2 THE NATURE OF COMPETITION IN THE INDUSTRY

The Pharmaceutical industry in general is widely viewed as being monopolistic in nature. The presence of substantial monopoly power in the pricing of a number of important

pharmaceutical products was first shown by a few early studies such as the U. S. Senate Report [1961] and Henry Steele [1962, 1964]. The same point was demonstrated again in studies such as Comanor [1964], Schifrin [1967] and Temin [1979] by using accounting rates of return. The attempts by Kenneth Clarkson [1977, 1979] to adjust the accounting rates of return to reflect the capital investment [intangible] nature of R and D and marketing expenditures following suggestions by earlier writers such as Cooper and Parker [1968] and Ayanian [1975] among others succeeded only to a limited extent. While being able to show lower economic rates of return he however failed to demonstrate that profits in the industry were not above normal. The success of his adjustments also depended on the rates chosen to depreciate these two investments. Thus in the words of Comanor "Even with Clarkson's assumptions, however, drug industry profit rates remain higher than average" [1986, p. 1185].

Market power is largely seen to be the result of barriers to entry into different submarkets within the industry which arise from large scale investments in R and D and marketing. These have led to first mover advantages [Bond and Lean 1977; Gorecki 1986]. To quote Comanor "Since effective entry normally requires some form of technical advance, the cost and risk of research comprise an important part of this barrier. Joined with Research and Development, moreover, are the extremely high

selling expenditures undertaken by the larger firms. Not only do these outlays accentuate the degree of differentiation among older products, but they also raise considerably the costs associated with launching a new product and thereby provide a further barrier" [1964, p. 380]. Other factors mentioned in the connection of entry barriers include oligopolistic collusion, patent protection and demand inelasticity in the product market. The last named is peculiar to the pharmaceutical market in the sense that it results from the divorce between the consumer who is the patient and the decision maker who is the doctor.

This is however not to suggest that market power enabled all firms to enjoy uniformly high profits. Thus Cooper [1966] found that in the British pharmaceutical industry profit leadership changed hands seven times in eleven years between 1954-64 and there were thirty-one instances of absolute losses among the leading fifty-five firms.

It is generally agreed that competition in many pharmaceutical submarkets relies more on innovation and advertisement rather than price. Schwartzman [1976], for instance, noticed the existence of price competition in only a few submarkets such as the antibiotics market wherein market shares could be maintained only by substantial price cuts. Bond and Lean [1977] examined sales and prices in two therapeutic areas and found that first mover dominance persisted even when confronted with

cheaper and highly promoted substitutes [also see Gorecki 1986] Similarly,Mier Statman [1981] found that physicians had so identified a drug with a specific brand name that sellers were able to maintain their market shares without price cuts even after the expiry of patents. Initial high prices, set after new product introduction, however, do decline in a phenomenon called 'skimming price' by Reekie [1978], but they are not significant. The price declines noticed by Cocks [1975] and by Cocks and Virts [1974] are also consistent with this observation. To quote Comanor "Because of effective brand loyalty, the original firm was not forced to meet the lower prices charged by new suppliers. While there were some price declines with increased competition, they were relatively small" [1986, p. 1189]. It is generally felt that where products are superior in quality they tend to enter the market priced at higher levels. If on the other hand, the new product does not have advantages in quality the seller relies more on price competition to enter a therapeutic market. The conditions under which a new entrant will price his product above existing competition are well enunciated by Reekie [1978] To quote, "If markets are composed of rival or 'effectively competitive' suppliers, if price collusion is weak or non-existent, and if product demand is wholly inelastic then firms will price major breakthroughs above the price of previously available alternatives" [Reekie 1978, p. 224].

Substitute competition as we shall call competition based on innovation and advertisement, has led to rapid product turnover. Product competition according to Comanor [1964] and Cocks [1975] resulted in extensive market share instability in the 1950's and 60's. They attributed this to the research process which led to rapid new product introduction thereby shifting market shares between firms. The question is why the predominance of substitute competition over price competition? The reasons are well described in Cooper [1966]. He argues that pharmaceutical products become obsolete too quickly for any real improvements in the manufacturing process to take place. There are few economies of scale to be gained in drug manufacture and demand inelasticity in the product market precludes price-cutting as an effective means of commercial progress. Demand responds to the incidence of sickness, and a particular drug's scales are determined by the extent to which the manufacturer gains 'doctor acceptance' for his product and implicitly thereby on sales promotion and R and D. Reliance on product innovation and sales promotion as the basis of competition has resulted in the industry being among the highest spenders on these two activities. Promotion has been found to be closely related to innovational activities and new product introduction in studies such as Schwartzman [1976], Telser et al. [1975] and Leffler [1981]. Since new products constitute an important

means of entry into the pharmaceutical market, advertising has been termed pro-competitive. Such a conclusion, however, would depend on whether one is considering product or price competition having different implications for both [Comanor 1986]. Product competition has been held responsible for impeding price competition by preventing the emergence of standardized commodities [Comanor 1964]. On the other hand Cocks [1975] and Reekie [1981] have stressed the importance of product competition and it has been claimed to be more beneficial to consumers welfare than price competition [Grabowski and Vernon 1979]. However, the overall assessment is not yet clear.

Our attention can now be turned to a description of certain aspects of the Indian pharmaceutical industry which forms the subject of study here. The Indian industry shares many of the features of its international counterpart. To begin with firms of all sizes coexist. Competition relies more on sales promotion and new product introduction rather than price. However, the new products are rarely the results of own R and D. The indutry has been known to spend only about 1.5% of its sales turn over[2] on research activities whereas international companies spend as much as 10% of their sales turn over. Thus the firms in the Indian industry can hardly be called research intensive. However, many of the leading firms are subsidiaries

2. Department of Science and Technology estimate, 1981-82.

of multinationals or have collaborative links with international companies and thus benefit from their R and D. A major feature of this industry which is probably unique is the presence of extensive Government intervention in the form of controls over the prices of pharmaceutical products and the profitability from their sale. The Government also determines what can be produced by fixing the ratio between the production of basic drugs and pharmaceutical formulations. Government policies are discriminatory towards multinationals and their subsidiaries and lay down separate guidelines for Indian and foreign enterprises. They also discriminate between the public and private sectors in the matter of what drugs can be produced. There is also the need for companies to seek approval from Government bodies equivalent to the FDA in the U. S. before marketing a new product.

Government policies towards the industry are intended to serve the aim of self-reliance and the need to prevent the industry from charging 'high' prices and making 'excessive' profits. The desire to intervene and fix prices arises due to the nature of the competition in this industry which is largely based on non-price methods. Moreover, the government shoulders the major portion of health care costs due to the low purchasing power of the people. There is thus pressure on it to economize.

Price and profit controls have become a major factor in the performance of Indian pharmaceutical firms whose profitabili

[pre-tax profits on sales] has steadily declined from 15.47% in 1969-70 to 7.5% in 1982-83 according to various sources. The industry has blamed controls as being mainly responsible for declining profitability although it must be borne in mind that the industry has also become increasingly competitive over the years due to the growth of a strong indigenous sector thus injecting that much more of price competition.

An emerging feature of Indian pharmaceutical firms is the gradual change in their structure. Pharmaceutical firms have been undergoing these changes both as part of long-run strategy and as a response to government policies. An important new structural feature is diversification. The strategy has been to diversify into areas relatively free from Government controls. Partly, diversification into other areas is the result of growth opportunities being blocked by government regulations in existing lines of production, such as the policy of having to seek licenses sanctioning capacity. Bellur et al. [1985] reported Company Chairmen as stating that they were minimizing the adverse effects of price controls by increasing the contribution to total sales of other products. They also reported 67% of the druggists interviewed in their study as saying that there had been more lay promotions on volume producing medical remedies, such as cough and cold remedies, after price controls went into effect. This means that company goals were being progressively modified to one of sales maximization because of

the prevailing circumstances. Production operations have also changed, becoming more integrated. Many early pharmaceutical firms began as trading concerns but have progressively gone in for backward integration, initially by commencing manufacturing operations from the penultimate stages of production. Most of the larger firms now undertake all manufacturing operations, packing, marketing and distribution within the organization. The growth in size of the pharmaceutical market has made this feasible, although government pressure can also be cited as a reason for this to have happened.

1.3 OBJECTIVES OF THE STUDY

In the description of the Indian pharmaceutical industry given above the important features mentioned were the presence of controls over prices and profits, the existence of a wide range of firm sizes, the increasing extent of diversification and vertical integration, the high advertising intensity and a general decrease in the average profitability of the industry as measured by the profitability on sales.

We may now pose a few questions. Firstly, how important were the structural features of the firms belonging to the industry in determining their profitability and secondly, what was the effect of changes in particular structural features on profitability? Further, did price controls affect profitability adversely and lastly, what was the relative importance of price

controls vis-a-vis the structure of the firm in determining the profitability of pharmaceutical firms? The objective of this study is to find the answers to these questions by estimating the relationships between profitability and the major structural features of the firms in the industry, viz., size, diversification, vertical integration, advertising intensity, growth and between profitability and the prices of drugs and pharmaceuticals. In order to capture the influence of these determinants on the profitability of the firms, our intention in this study is to examine them first one by one and then jointly which will thus provide us an indepth analysis of the problem. This approach is in contrast to the piecemeal approach adopted by earlier studies investigating these questions such as Ramachandran [1980] and Narayana [1984]. Ramachandran [1980] investigated the relationship between profitability and size alone whereas Narayana [1984] undertook an indepth analysis of the effect of price controls on profitability. Both studies, however, failed to include other structural determinants in their studies. A complete analysis requires that other important structural variables also be included. The present study is an attempt in this direction.

1.4 ARRANGEMENT OF THE CHAPTERS

The rest of the chapters of this study are arranged as follows. The second chapter describes the methodology adopted

in doing the analysis, the sample and the data. Chapter three through chapter eight consider each explanatory variable though not necessarily in any order for empirical investigation. Each of these chapters also contain a survey of the relevant literature, specification of the models for estimation and related description. Chapter nine presents the results of the test of the full model. The last chapter provides a summary of the study and the main conclusions together with some implications.

CHAPTER 2

METHODOLOGY, SAMPLE OF THE STUDY AND DATA

2.1 METHODOLOGY

As mentioned in the introduction, the objective of this study is to assess the importance of certain structural variables for determining the profitability of the firms in the Indian drugs and pharmaceutical industry. This would be a quantitative analysis for which we have chosen a single equation regression framework as the method of analysis. The relationship between profitability and the factors considered viz.,size, degree of diversification, vertical integration, advertising intensity, growth of the firm and drug prices is planned to be studied initially by regressing profitability on each of these variables by using separate models. Thus, we have simple hypotheses for testing like profitability of the firm is a function of its size, or profitability is a function of the degree of diversification and so on. The emphasis in this analysis is on studying the effect of a change in a particular dimension of the firm on its profitability using time-series data. This would be supplemented by a preliminary cross-section analysis of the concerned relationship. At the end of this analysis a full model is postulated for estimation in which all the proposed determinants of profitability appear

together. That is, profitability of a firm is assumed to be a function of i its size, degree of diversification, degree of vertical integration, advertising intensity and growth. This model, of course, would be fitted using cross-sectional data. The effect of price controls on the profitability of the firms is being examined separately because of data constraints.

2.2 ESTIMATION METHODS

The estimation of the regression models is done using the ordinary least squares method. In computing the regressions, checks are made at various stages for model violations. A common problem faced in studies using time-series data and to a lesser extent with cross-section data is the presence of autocorrelation among the disturbance terms. The nature of the auto-regressive process followed by the disturbance term can be different, such as the first-order scheme [AR(1)], the second order scheme [AR(2)] and so on. In computing the regressions, checks are made for the presence of first-order autocorrelation among the residuals by computing the Durbin-Watson statistic [Durbin and Watson 1950, 1951]. The computed Durbin-Watson statistic is compared at the .01 level with the table values given in Savin and White [1977]. Where the presence of autocorrelation is indicated, the iterative procedure suggested by Cochrane and Orcutt [1949] is applied and the regression equation is re-estimated.

The second problem commonly faced in regressions using cross-section data is heteroscedasticity. One method which can be used to detect its presence is a scatter plot between the explanatory variable thought to be responsible for the heteroscedastic disturbances and the square of the residuals. This, however, does not yield a discernible pattern in the present case on account of the relatively small sample size. So instead, the test proposed by Breush and Pagan [1979] is applied. The Breush-Pagan test statistic follows the Chi-square distribution with p-degrees of freedom, where p is the number of regressors excluding the intercept term. This test is also conducted at the .01 level. The heteroscedasticity in the disturbance is modelled by $\sigma_t^2 = \frac{\sigma^2}{X_{jt}}$ $t = 1, \ldots, n$ where X_j is the explanatory variable thought to be responsible for the heteroscedastic disturbances. Where the Breush-Pagan test indicates the presence of heteroscedasticity the correction made is to weight the variables occuring in the regression by the square root of the causal variable. A weighted regression is then estimated. Thus if the original regression equation took the form

$$Y_t = a+b\ X_{1t} + u_t \qquad t = 1, \ldots, n$$

where X_1 is thought to be responsible for heteroscedasticity the transformed model for estimation purposes would be

$$Y_t \sqrt{X_{1t}} = a\sqrt{X_{1t}} + bX_{1t}\sqrt{X_{1t}} + u_t\sqrt{X_{1t}} \ .$$

As the choice of the weighting variable tends to be different in different sections of the study the variable chosen to weight the concerned equation is mentioned in the appropriate sections.

For computing the goodness of fit statistics in the case of weighted regressions the methodology suggested by Buse [1973] is followed.

Lastly, the presence of multicollinearity cannot be ruled out in multivariate regressions. To detect multicollinearity the method adopted is to scan the simple correlation coefficients for the existence of any high correlation between the explanatory variables. As the presence of a low simple correlation coefficient alone does not necessarily imply that the variables are not collinear, the estimates are checked for stability by dropping a few observations and re-estimating the regressions. As such, therefore, it can be said that thorough checks were made for model violations and appropriate corrections undertaken so that the estimates are rugged.

2.3 THE SAMPLE

The choice of the sample and the quality of data are the major determinants of the results of such studies. Therefore, in chosing the sample for the study, three considerations were borne in mind :

(a) The firm must be a major producer in the pharmaceutical industry. This being the age of multi-product, diversified firms an essential criterion is that a large share of the firm's produce must be in pharmaceuticals.

(b) The sample must, as far as possible, be representative of the industry.

(c) To ensure the quality of data, the sample must be restricted to the organized sector of the industry.

In keeping with the above criteria, the sample is drawn from the pharmaceutical firms listed in Volume 14, Subsection 31 of the Stock Exchange Official Directory published by the Stock Exchange Foundation, Bombay. The Directory also publishes an analysis sheet for each listed firm which gives a summarized version of the Profit and Loss statement, and the Balance Sheet. The firms chosen from this directory are supplemented by other firms, the source of which is the Balance Sheet Library of the Department of Company Affairs, Government of India, Delhi. In total, the sample consists of thirty-eight firms. A listing of the firms that constitute the sample is provided in Appendix 2A.

The sample chosen is fairly representative of the industry in the sense that there are both Indian firms and multinationals as also firms belonging to the private and public sectors. The sample also includes firms which is the eyes of the government were relatively large and therefore attracted

the Monopolies and Restrictive Trade Practices Act, 1969. The Act is applicable to two types of Companies :

(a) Those which on their own or along with their inter-connected undertakings hold atleast one-third share in their line of production and at the same time control assets of not less than Rs. 1 crore.

(b) Those which on their own or along with their inter-connected undertakings control assets of not less than Rs. 20 crores.

Some firms in the sample mainly subsidiaries of multinationals, are also governed by the Foreign Exchange Regulations Act.

As previously mentioned, the sample represents only the dominant organized sector. This is so not only because the quality of data would be better, but also because this sector of the industry holds a competitive edge over the smaller un-organized or small-scale sector. Competition is largely restricted to the firms in the organized sector and it is their conduct in the product market that decides Government policy towards the industry.

A look at the product structure of the firms in the sample to determine the extent to which the firms are based in the pharmaceutical industry reveals that only in the case of five does the sales from basic drugs and pharmaceuticals on the average account for less than 50% of the total sales turnover.

Even among these firms 30% to 35% of sales is attributed to basic drugs and pharmaceuticals. Only one firm in the sample has less than 30% of its total turnover coming from the sale of pharmaceuticals. The figures indicate that these firms are more diversified into other areas of production than the rest of the firms in the sample. However, pharmaceuticals still account for the largest component of their total sales turnover. The firms in the sample are thus largely based in the pharmaceutical industry.

2.4 THE DATA

The study as already proposed is to be conducted using both time-series and cross-section data. Studies based on time-series data require that the data-series be sufficiently long to get consistent estimates. Keeping this in view, a fourteen year time-period is chosen, with the initial year being 1970, the year in which a major Drug Price Control Order [DPCO, 1970] was passed, and the terminal year being 1983, then the latest year for which data was available.

The basic source of data is the Stock Exchange Official Directory. However, as this proves inadequate the data available there is supplemented with data, especially on advertising expenses and product structure, from the various Annual Reports of the Companies in the sample.

A problem with the data is that the series available in the Stock Exchange Directory are not complete in quite a few cases. To the best extent they are completed using data from the Annual Reports. However, due to the non-availability of certain Annual Reports the time-series could not be completed for all firms. Two firms in the sample were also incorporated during the time-period under study. There is thus a discrepancy in the length of the time-series data available for different firms. The problem is not so serious in measuring profitability, size, vertical integration and growth. The problem is more serious in computing the other two structural variables, viz., advertising intensity and the extent of diversification. The data necessary for computing these two variables, viz., advertising expenditure and product-wise sales turnover, was available with any kind of regularity only from the year 1973 or so, following the Reserve Bank of India's instructions on how to present profit and loss accounts. Even then the reporting tended not to uniform. Some firms in the sample started reporting the data later in the time-period, some not at all, or the reported series was too short to be used in the analysis. Consequently, the sample size, in the different sections of this study, tends to vary, with certain firms having to be dropped in some sections due to a lack of data. Changes in sample size and other specific problems with the data are reported in the concerned chapters. The size of

the sample available for the cross-section analysis conducted at different time points over the period also varies especially at the beginning and end of the time-period for the same reasons mentioned earlier.

Lastly, a number of variables appear in the regression models presented in this study. The definitions of the variables and their measurement aspects are discussed in the sections where they are first used.

APPENDIX 2A

LIST OF COMPANIES

1) Duphar-Interfran, Ltd.
2) Glaxo Laboratories (India), Ltd.
3) Boehringer-Knoll, Ltd.
4) Amrutanjan, Ltd.
5) Rallis India, Ltd.
6) Searle (India), Ltd.
7) Unichem Laboratories, Ltd.
8) Warner-Hindusthan, Ltd.
9) Reckitt and Colman of India, Ltd.
10) Standard Pharmaceuticals Ltd.
11) Pfizer, Ltd.
12) Boots Co. (India), Ltd.
13) Chemo-pharma Laboratories Ltd.
14) Alembic Chemical Works Co., Ltd.
15) Cadilla Laboratories Ltd.
16) Richardson Hindusthan, Ltd.
17) The Chemical, Industrial and Pharmaceutical Laboratories, Ltd. (CIPLA)
18) The Nila Products, Ltd.
19) Ranbaxy Laboratories, Ltd.
20) Sandoz (India), Ltd.
21) German Remedies, Ltd.
22) Bayer (India), Ltd.
23) J. L. Morrison, Son and Jones (India), Ltd.

24) Albert David, Ltd.

25) Geoffrey Manners and Co. Ltd.

26) Cynamid India, Ltd.

27) Infar (India), Ltd.

28) Hoechst India, Ltd.

29) Parke Davies (India), Ltd.

30) Hindusthan Ciba-Geigy, Ltd.

31) Roche Products, Ltd.

32) E. Merck (India), Ltd.

33) Roussel Pharmaceuticals (India), Ltd.

34) Hindusthan Antibiotics, Ltd.

35) Indian Drugs and Pharmaceuticals, Ltd. (IDPL)

36) Merck Sharpe and Dohme

37) Burroughs Wellcome and Co. (India), Ltd.

38) Curewel (India), Ltd.

CHAPTER 3

PROFITABILITY AND SIZE

3.1 INTRODUCTION

The size of a firm is an important determinant of its profitability. Size influences profitability either directly or through the conduct of large firms operating in the market. Large firms may erect barriers to entry into the market which gives them a measure of monopoly power. This allows them a degree of independence in their pricing and output decisions which subsequently influence their performance. Mechanisms by which large firms erect entry barriers include research and development, advertising and oligopolistic collusion. Large size may also be advantageous or disadvantageous from the point of view of technical and pecuniary economies. Sources of technical economies that are commonly mentioned include :

(a) Economies of scale arising from "the actual physical organization of production activities" [Shepherd 1979]. Increased specialization of both men and machines or in other words the greater division of labor produce more output from a given input [also see Adam Smith 1937, Book I, Chp. 1-3].

(b) Economies arising from 'Physical Laws' favouring large size such as area - volume relationships [Scherer 1980, pp 82-83; Shepherd 1979, pp.232-233].

(c) Economies of massed reserves. Large firms have enough reserves of equipment and goods to tide-over sudden breakdowns in production or in meeting an unprecedented increase in demand [E.A.G. Robinson 1958, pp. 26-27].

Pecuniary economies can arise from the following sources:

(a) The ability to spread fixed costs over a large volume of output reducing the average cost of the commodity produced.

(b) Volume discounts when inputs are purchased in bulk. Large firms may possess a degree of monopsony power which puts them in a position of strength in bargaining situations. Cost savings arising from technical economies realized by an independent supplier may also be passed on to large buyers of the input.

(c) Economies in pooling managerial resources when a large firm operates a number of plants.

(d) Economies in raising capital through borrowing, or by the issue of fresh stock. Fixed transaction costs can be spread over a greater volume of borrowing reducing the average cost of capital raised. Besides, investments in large firms are treated as less risky because the chances of bankruptcy are smaller. Variation in

earnings may also be small. Riskless investors may therefore prefer large firms even if the interest rates offered are low. Investments in well diversified large firms are considered equivalent to investments in diverse portfolios [Prais 1976;Scherer 1980, pp. 104-108; Sawyer 1981, pp. 69-70].

There are also economies in the conduct of large scale research and development, advertising, marketing and distribution undertaken by big firms. For example, a big laboratory can justify the purchase of specialized equipment which make experimentation easier. It may also be able to hire specialists in many disciplines [Scherer 1980, p. 414].

Large-scale advertising helps product differentiation thus enabling higher prices to be set. Heavy advertising also raises capital barriers to entry, making entry costlier. Scale economies also exist in marketing and distribution. For instance marketing has low marginal costs once the network is in place [Scherer 1980, pp. 108-116; Sawyer 1981, pp. 103-121].

Offsetting economies of scale of large size are the diseconomies of scale. The chief source of such diseconomies is a large management. Diminishing marginal returns set in as the size of the management increases beyond a threshold level. Increases in management size correspond to increases in firm size to co-ordinate the activities of different branches and

thereby sprouting different layers of administrators. This leads to costly delays in transmitting information to and from the decision-makers. Further difficulties arise in monitoring. If a top controller is presumed to exist, at the apex of the hierarchy, in a pyramidal setup, his capacity to take efficient decisions diminishes as the volume of decisions to be taken increase thus leading to diseconomies [Williamson 1967; Scherer 1980, p. 85]. Other diseconomies may arise from :

(a) Increase in transportation costs when the market is well dispersed geographically but production is undertaken centrally by large firms as in the case of low value, large bulk commodities.

(b) Industrial relations may deteriorate as the scale of operations increase [Sawyer 1981, p. 55].

(c) Wages increase with plant size. Higher wages may have to be paid to attract workers as they frequently express dissatisfaction with their jobs in large plants [George et al. 1977].

(d) Physical limits exist to area - volume relationships. Exceeding them bring decreasing returns.

(e) Lastly, there exists a threshold effect on the level of effective advertising [Ackoff and Emshoff 1975] and on the size of firm for conducting research and development [Markham 1965]. There is also the danger of R and D being overorganized in large firms. Effectiveness could therefore, diminish beyond a threshold level.

Economies/Diseconomies of size and the market power of large firms have a direct bearing on their performance. Manifestations of market power can be found in their ability to administer prices [Gardiner Means 1939] either individually or through the formation of an oligopolistic cartel. Other practices include restriction of output and price discrimination [see Clarkson and Miller 1982, Chp. 13 for thorough review]. All these factors have an important bearing on performance. Viewing its importance in determining performance it becomes imperative to include size as an important structural variable determining profitability.

3.2 SIZE AND THE PHARMACEUTICAL INDUSTRY

There prevails a view that economies of scale in pharmaceutical manufacturing may be ruled out as "products often become obsolete too quickly for any real improvements in manufacturing processes to take place" [Cooper 1966, p. 41]. This, while being true in many areas of pharmaceutical production is not true in totality. There do exist certain well established bulk drugs such as vitamins or antibiotics such as penicillin whose production is undertaken on a sufficiently large scale for economies to exist as also improvements in manufacturing to take place.

There is also evidence of substantial scale economies in research and development and marketing undertaken on a big scale by large firms although, as not infrequently, it is not unanimous. The evidence comes from Schwartzman [1976] who related a sample of all new chemical entities introduced between 1965-70 with size finding that large firms discover relatively more drugs than small firms. However, Schnee [Mansfield 1971] studying only the major innovations found that it was the smaller firms which contributed the most innovations. Alan Angilley [1973] related indices of innovative output to research input clearly finding constant returns to scale. This may be interpreted to mean that large firms which invest more on R and D produce more R and D output. The findings of Comanor [1965] and, Loeb and Lin [1977] also differ. They found increasing economies at smaller values of firm size beyond which diminishing returns seemed to set in. Vernon and Gusen [1974] found diminishing returns to scale of increasing R and D size, but there were increasing returns to locating fixed R and D staff in large firms which they felt led to larger firms having an advantage over smaller firms in the development of new chemical entities. The evidence on scale economies in R and D is best summed up by concluding that larger firms were relatively more important when all new drugs were included but were not so important when only the most important innovations were considered [Comanor 1986, p. 1193].

Economies from advertising are mostly in the nature of increased market power. Walker [1971] argued that large pharmaceutical firms achieved market power by their huge outlays on advertising and promotion whose main purpose was to place smaller firms and new entrants at a competitive disadvantage.. The relation between promotion and scales was found to be brand specific depending on the product's therapeutic characteristics and its position in the innovative race. Product differentiation thus resulted in smaller firms being forced to rely on standardized and non-patented products which were frequently non-competitive [Comanor 1964]. Large firms thus held the advantage. The importance of advertising in determining performance will be considered separately and in greater detail in a subsequent chapter. We can now turn our attention to a comparative picture of the importance of size in the Indian pharmaceutical industry.

3.3 THE INDIAN SCENARIO

As in the case of the international industry scale economies in pharmaceutical formulations production may be absent. Besides, in the Indian industry scale economies resulting from large scale R and D may also be absent. As stated before the expenditure on R and D amounts to only a very small percentage of scales turnover bordering on 1.5%. While there may be no economies of scale in R and D undertaken locally, the subsidiaries of multinationals still benefit from the R and D

activities of their principals abroad. This arrangement while saving them the risks and costs of locally undertaken R and D nevertheless places them in monopolistic situations in many markets. In fact, Singh [1985] found that out of the 102 submarkets as many as 47 had only one firm operating in them while 19 had two. Only twenty-two submarkets had more than 5 firms operating in them.

Substantial economies may however exist in sales promotion and marketing. An NCAER study had put the expenditure on sales promotion at 13.7% of sales turnover in 1980. Other economies resulting from large size include scale economies in Quality Control [U.N. 1979, p. 35]. Firms of large size can provide a degree of assurance of drug efficacy and safety, which smaller firms cannot, by maintaining a large quality control division with persons of specialized skills as staff. The larger firms have an advantage in being able to spread the costs of quality control over a larger output.

Another reason why size is important in the Indian context is because firms of large size may be in a better position to withstand regulation. Because large firms are more diversified they can undertake cross-subsidization and continue to operate in the industry even when profitability is low whereas smaller firms may be forced to quit. Lastly, the possibility cannot be ruled out that large firms in the Indian pharmaceutical industry enjoy market power in the pricing of drugs free

from price control and are also more successful in protecting their market shares from competitive pressures.

3.4 EMPIRICAL EVIDENCE

The empirical evidence on size-profitability relationships in general is quite vast and varied. Studies which reported a negative relationship include Crum [1939], Singh and Whittington [1968], Haines [1970], Radice [1971], Shepherd [1972], Smyth, Boyes and Pesau [1975], Whittington [1980], Pomfret and Shapiro [1980], Ravenscraft [1983] and,Amato and Wilder [1985].
Studies which reported a positive relationship include Steindl [1945], Alexander [1949], Hall and Weiss [1967], Samuels and Smyth [1968], Kamerschen [1968] and Marcus [1969].
Stekler [1963] detected a parabolic relationship.

Both Crum [1939], and Singh and Whittington [1968] obtained their results by considering only profit making firms. Steindl [1945] attributed Crum's results to the increasing capital intensity of production in large firms. Singh and Whittington's investigations stressed the underlying specification of the relationship and discovered a semi-logarithmic specification to be the best fit. Haines [1970] reported low rank correlation between profitability and invested capital but on discovering that small and medium-sized firms appeared more frequently among the most profitable firms, determined the

relationship to be negative. His study has been critized for not taking account of the influences of market structure, growth and economy-wide fluctuations on profitability [Koch 1980, p. 160]. A negative but not highly significant asscciation of size with profitability was also reported by Shepherd [1972] in his study of large but relatively undiversified firms. His approach was more comprehensive taking account of several firm and market structural variables. The objective of Smyth et al. [1975] was to compare the size-profitability relationship for the U. S. and the U. K. as also to examine whether the relationship held for alternate measures of profitability [rate of return on equity and rate of return on assets] and size [sales, assets, employment and equity]. The results they obtained were mixed. Equity was found to be strongly and negatively related to the profit-equity ratio and positively related to profit on assets. The other measures of size were found to be negatively and significantly related to both measures of profitability in the U. K. whereas in the U. S. a negative relationship resulted when profitability was measured by profits on assets while no significant relationship was observed when the profitability measure used was profits on equity. Overall, their conclusion was that size differences accounted for only a small proportion of inter-firm differences in profitability. In almost a repetitive study Whittington [1980] used four different measures of size [Net

assets, gross assets, sales and value - added] to examine its influence on profitability [rate of return on net assets]. The different size measures barring value-added exhibited a weak negative relationship whereas the use of the value-added measure revealed a positive relationship. Overall, he concluded, average profitability was largely independent of size which was also the conclusion of Pomfret and Shapiro [1980] in their study of large Canadian firms and of Amato and Wilder [1985] in their study using grouped U. S. data. Ravenscraft's study was done at a much finer level using line of business data. He too found a weak negative relationship between line of business profitability and line of business assets [Ravenscraft 1983].

Among the earliest studies reporting a positive relationship was Alexander [1949] who explained his findings in terms of loss-making small firms suffering higher rates of loss as compared to loss-making large firms which hid the slightly higher rates of return that small profitable firms earned when compared to profitable large firms. The most prominent study reporting a positive relationship is Hall and Weiss [1967]. Their basic objective was to test the effect of size advantages resulting from capital barriers to entry on profitability. Their study has been subjected to criticism on three grounds. Firstly for combining time-series and cross-section data. Secondly for non-consideration of entry and exit of firms from

the top 500 which was their sample. Lastly, the period was a boom period and the relationship may have been overstated [Smyth et al. 1975]. The positive results of Hall and Weiss does get some support from Samuels and Smyth [1968]. Their study, however, was carried out by arranging firms by size class when, profit rate was found to decline with size. Kamerschen [1968] included size as part of a broader study of management control and performance. Both his measures of size [sales and total assets] were found to have a positive relationship with profitability [rate of return on invested capital]. Finally, according to Marcus [1969] any broad industry grouping would reflect inter-industry variations in rates of return and in firm-size distribution and thus would not indicate the presence of a size effect within individual industries. Further, all inter-industry differences cannot be controlled for. Therefore, studying the size-profitability relationship separately for individual industries he found a positive significant relationship between profitability and size prevailing in only 35 out of 118 3-digit industries, which was his sample. Incidentally, the profitability-size relationship was found to be positive in the drugs industry.

There has been only one systematic empirical study on profitability and size in the Indian pharmaceutical industry, that by Ramachandran [1980]. His period of study was 1965-72, the measure of profitability and size used were rate of return

on net assets and net assets respectively. Classifying the 19 firms that was his sample by size, origin [Indian or foreign] and by different sub-periods, he computed the average profitability measure for each group. He found that medium-sized firms recorded higher profitability as compared to large and small firms. His analysis also showed that following the imposition of price controls profitability of small firms had declined while that of the larger firms remained unaffected. The medium-sized firms had improved their profitability. Also, firms of foreign origin showed higher profitability than firms of Indian origin. A semi-logarithmic regression specification showed a positive but insignificant relationship in the all company and Indian samples while the foreign company sample showed a negative significant relationship. Ramachandran's study may be faulted for his small sample size, for not controlling for inter-firm differences in other structural variables and for not exploring alternative specifications of the profitability - size relationship. Lall [1974] also implies a positive correlation between profitability and size when he says that medium and large drug firms recorded on an average, profit before tax on capital employed of 20% in every year between 1965 and 1971 whereas the average for all firms was 10%. This was in the period before the imposition of stringent controls on prices and profitability. The two other studies

which have considered this issue in passing are the Hathi Committee report[1] and Narayana [1984]. The Hathi Committee felt that size did not have any significant influence on profitability. The profitability on sales of companies having an annual sales turnover greater than Rs.5 crores was found to be slightly better than for other smaller and intermediate sized units, although it was not significantly different. Narayana [1984], on the other hand, found a direct relationship between profitability and size measured by sales turnover, and arranged by class intervals. He attributed this to the ability of large firms to spread their fixed costs over a larger volume of output.

We can now turn our attention to some of the likely explanations forwarded in the literature for the observed size-profitability relationship. One explanation is scale economies and market power resulting from large capital requirements. This theme can be found for instance in Steindl [1945] and Baumol [1967] and is also reflected in Hall and Weiss [1967], Shepherd [1972] and Ravenscraft [1983]. Baumol argued that large firms possess increased money capital which puts them in the higher echelons of imperfectly competing capital groups. Effective in industries requiring large investments and experiencing economies of scale large firms earned a higher return per

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1. Government of India - Report of the Committee on Drugs and Pharmaceutical Industry, New Delhi, 1975.

unit of investment. Shepherd and Ravenscraft approached the issue of market power indirectly by including variables such as concentration and market share along with size. The result to quote Ravenscraft "The profit concentration relationship in industry regressions almost surely reflect advantages that large sellers enjoy relative to smaller rivals" [Ravenscraft 1983, p. 29]. This kind of a profit-concentration relationship is possible according to Demsetz, only if superior efficiency explained high concentration and high profits. Large firms are more successful at innovating and gain in market share and profits as their long-run average cost curves shift downwards [Demsetz 1973]. Shepherd [1972] also took recourse to efficiency in explaining the negative profitability-size relationship he observed, suggesting X-inefficiency in large corporations as a plausible reason.

The strategic groups argument [Caves 1977; Newman 1978; Porter 1979] also tries to put forward an explanation. Every industry is taken to consist of a number of strategic groups defined by the height of mobility barriers. The profitability-size relationship would depend on the height of such barriers, the interaction between strategic groups and the structure within the groups. If leading firms operated in strategic groups protected by mobility barriers and are shielded from inter-group rivalry, the relationship between profitability and size would be positive. The relation may be negative if smaller firms

achieved a higher level of product differentiation, greater technical know-how and no scale economies existed while larger firms followed broad-line strategies with a low degree of product differentiation.

Pure 'chance' has also been suggested to explain observed profitability-size relationships [Mancke 1974]. He reasoned that neither scale economies nor monopoly power could be used to explain a positive relationship. Firms which were 'luckier' in enjoying successes on previous investments would record higher profits, market share and growth. The level of these variables would differ in different firms solely by 'chance'.

Differences in objectives can also explain why the profitability-size relationship may differ between firms. The objective of sales maximization [Baumol 1967] leads to larger sizes in terms of sales but lower profitability in the short run when compared to profit maximization. Also, in modern Corporations characterized as they are by divorce between the ownership and management, the management may replace profit maximization by managerial utility maximization as the objective of the firm [Williamson 1963]. This can also be responsible for an observed negative relationship between profitability and size.

It is thus clear that there is no unanimity regarding either the direction of the profitability-size relationship or in the explanation of the underlying causes of the relationship.

3.5 THE EMPIRICAL ANALYSIS : SPECIFICATION OF MODELS

The objective of this section is to make a study of the effect of size on profitability independent of other factors such as the degree of diversification and vertical integration, advertising intensity etc., which are considered later. In a sense this section of the study follows the format of earlier studies such as Marcus [1969], Singh and Whittington [1968], Whittington [1980], Smyth et al. [1975] and Ramachandran [1980].

To investigate the relationship between profitability and size three basic specifications are proposed viz.,linear, semi-logarithmic and quadratic. Two measures of profitability and size are considered. This is done following Bates [1965] and Smyth et al. [1975] who have shown that although the different measures of size are closely related, the conclusions obtained from size-profitability studies are apt to vary depending on the measure of profitability and size used. For instance, a sales maximizing firm would not show a very high level of profitability if it is measured in terms of profitability on sales turnover.

Under each of the three basic specifications, three different models are proposed interchanging the different measures of profitability and size. They are described below.

(a) Linear

$$P_1 = a + b_1 SIZ_1 + u \qquad (3.11)$$

$$P_2 = a + b_1 SIZ_2 + u \qquad (3.12)$$

$$P_2 = a + b_1 SIZ_1 + u \qquad (3.13)$$

(b) Semi-logarithmic

$$P_1 = a + b_1 \text{ LOG } SIZ_1 + u \qquad (3.21)$$

$$P_2 = a + b_1 \text{ LOG } SIZ_2 + u \qquad (3.22)$$

$$P_2 = a + b_1 \text{ LOG } SIZ_1 + u \qquad (3.23)$$

(c) Quadratic

$$P_1 = a + b_1 SIZ_1 + b_2 SIZSQ_1 + u \qquad (3.31)$$

$$P_2 = a + b_1 SIZ_2 + b_2 SIZSQ_2 + u \qquad (3.32)$$

$$P_2 = a + b_1 SIZ_1 + b_2 SIZSQ_1 + u \qquad (3.33)$$

where,

P_1 is the ratio of net profits to total sales turnover.

P_2 is the ratio of operating profits to total assets.

SIZ_1 is a measure of firm size represented by total sales turnover.

SIZ_2 is a measure of firm size represented by total assets.

$LOGSIZ_1$ is the logarithm of SIZ_1 to base 10.

$LOGSIZ_2$ is the logarithm of SIZ_2 to base 10.

$SIZSQ_1$ is the square of SIZ_1.

$SIZSQ_2$ is the square of SIZ_2.

u is the random disturbance term.

Net profits is defined as profits net of taxes, interest and depreciation.

Operating profit is defined as profit net of taxes and depreciation. Interest is included in the measure of operating profit following Shepherd who argued that although interest is the cost

of a part of the firms capital it is also a return on capital [Shepherd 1979, p. 267]. Total assets is measured as Fixed assets + Current assets.

The linear specifications postulate that profitability would change by a fixed amount for a given constant change in absolute size whereas the semi-logarithmic specifications postulate that a constant proportionate change in size would cause a constant change in profitability. The quadratic specification tests the presence of a curvi-linear relationship between profitability and size by including a quadratic term in firm size.

The variables are being interchanged in the different models which have been proposed to avoid downward bias in the estimates of the slope coefficient brought about by the explanatory variable also being present in the denominator of the dependent variable [Whittington 1980]. For instance, while sales turnover is an explanatory variable it is also present in the denominator of the dependent variable, the ratio of net profits to sales turnover, and this may lead to a negative bias in the estimates of the size coefficient.

Finally, a note on the sample. The sample consists of all thirty-eight firms in the full sample. For twenty-five firms the length of the available time-series data on profitability and size is fourteen years, for ten firms it is thirteen years and for one firm it is twelve years. In the case of the two

firms incorporated during the period of the study the length of the time-series data available is eight and ten years respectively. This also explains why the number of observations available for the cross-section computations vary from year to year.

3.6 REGRESSION RESULTS : CROSS-SECTION

Tables 3.1(a) to 3.1(i) present the results of the regressions using cross-section data. The regressions were computed for every year in the time-period but only a sample of the results is presented here. It must be mentioned that the Durbin-Watson test does not reveal the presence of spatial autocorrelation among the residuals in any regression. However, the Breush-Pagan test reveals the presence of heteroscedasticity in a few regressions. These regressions are re-estimated by weighting the variables by the square root of the explanatory size variable in that regression. The theoretical justification for the weighting given in Hall and Weiss [1967] and Shepherd [1972] is that the variance of profit rates in large firms is less than that in small firms. Consequently, the sum of squares of residuals from the least-square fit would be proportional to the inverse of size. As a result of the weighting the standard errors of the estimated coefficients are seen to decrease.

Tables 3.1(a) to 3.1(c) contain the results of the linear specifications. Table 3.1(a) reports the results obtained using regression model 3.11 in which the dependent variable is the ratio of net profits to total sales turnover (P_1) and the explanatory variable is total sales turnover (SIZ_1). The size coefficient is by and large negative in sign but the t-test shows that it is significant in only one regression. The goodness-of-fit statistics ($\bar{R}^2$ and F) are either low or insignificant. In general, the model has not performed well.

Table 3.1(b) contains the results obtained using model 3.12 which involves regressing profitability measured by the ratio of operating profits to total assets (P_2) on size measured by total assets (SIZ_2). This regression shows improved results. The size coefficient is negative in every regression. The t-test shows that the size coefficient is significant at different levels in four regressions. The computed F-statistic is significant in three regressions, at the .05 level. Comparison with the results obtained using model 3.11 reveals improved $\bar{R}^2$s and F-statistics showing this model had performed better. However, the presence of a negative bias in the estimate of the size coefficients on account of the explanatory size variable being also present in the denominator of the dependent variable cannot be entirely ruled out. Also, in terms of quantitative magnitude size comes off poorly with a difference of Rs.10 crores in size leading to a difference in

profitability ranging from 0.5 percentage points [in years 1981, 83] to a maximum of 1.8 percentage points [year 1970]. The results, however, consolidate the results obtained by using model 3.11.

Table 3.1(c) presents the results obtained by using model 3.13 involving the ratio of operating profits to total assets (P_2) as the profitability measure and total sales revenue as the measure of size (SIZ_1). The sign on the size coefficient varies, being positive in the early years and negative later. However, the t-test shows the size coefficient to be insignificant in all regressions. The goodness-of-fit statistics also show that the regressions had not performed well. A comparison with the estimates obtained by using model 3.12 [Table 3.1(b)] shows a change in the sign of the estimates in some regressions. This seems to confirm the presence of a negative bias in some of the earlier estimates. The sign on the size coefficient changes, from being negative earlier, to positive. The estimates obtained using this model are probably free from bias as the explanatory variable and the variable in the denominator of the profitability measure are different.

Tables 3.1(d) to 3.1(f) contain the regression results using the semi-logarithmic specification. When model 3.21 is used $LOGSIZ_1$ is positive in almost all the regressions but is insignificant as shown by the t-test [see Table 3.1(d)]. This

contrasts with the negative size coefficients obtained using model 3.11 wherein the size measure is SIZ_1 [Table 3.1(a)]. When P_2 is regressed on LOG SIZ_2 using model 3.22 the coefficient of size is found to be positive in sign in some regressions [Table 3.1(e)]. This is unlike the results obtained using the linear model 3.12 [Table 3.1(b)] wherein the size coefficient (SIZ_2) is uniformly negative. Moreover, in both Tables 3.1(d) and 3.1(e) the coefficient of size is not significant in any regression. This is in contrast to Table 3.1(b) where P_2 when regressed on SIZ_2 using model 3.12 resulted in some significant size coefficients. This again points to a negative bias in the estimates obtained using the linear model 3.12. Conversion to logarithms has probably reduced the extent of bias. The semi-logarithmic specification has, however, not yielded better results than its linear counterpart, in terms of improved explanatory power. The use of LOG SIZ_2 as the size variable in fact results in the explanatory power being poorer as can be seen by a comparison of the $\bar{R}^2$ values in Tables 3.1(b) and 3.1(e). Also, while the F-statistics are significant in a few regressions in Table 3.1(b) that is not so in Table 3.1(e).

The use of model 3.23 wherein P_2 and LOG SIZ_1 are the profitability and size measures results in the size coefficient being positive in all the regressions. This can be seen in Table 3.1(f) However, the coefficient of size is found to be significant in

only one regression and that too at the .10 level. Again, this model is not found to be in any manner superior in explanatory power to its linear counterpart, model 3.13, if one compares the results presented in Tables 3.1(c) and 3.1(f).

Tables 3.1(g) to 3.1(i) present the results of the regressions using the quadratic specification. When model 3.31 is tried, wherein P_1 is the profitability measure and SIZ_1 the size measure, the quadratic term in size $SIZSQ_1$ is found to be significant in two regressions [see Table 3.1(g)]. In the year 1977, the quadratic term in the weighted regression is significant at the .01 level and also carries the expected negative sign. The F-statistic is also significant at the .01 level in this case. In the other regression [year 1983] however, the quadratic term in size $SIZSQ_1$ is positive in sign and significant only at the .10 level. The sign on the linear term is negative. The use of model 3.32 [see Table 3.1(h)], results in the finding of a quadratic relationship in the years 1970 and 1972 but not in the years 1977 and 1983. The sign on $SIZSQ_2$ is the expected negative in both cases. In the second case, however, it is found to be significant at only the .10 level. The F-statistic is significant in one regression [year 1970] at the .01 level. Comparison using $\bar{R}^2$'s shows that the quadratic fit using model 3.31 in the year 1977 [Table 3.1(g)] has greater explanatory power than the linear fit using model 3.11 [Table 3.1(a)]. So also, model 3.32

[Table 3.1(h)] provides a better fit in the years 1970 and 1972 when compared to the linear model 3.12 [Table 3.1(b)]. However, in the years 1981 and 1983 model 3.12 is found to have better explanatory power.

The results of the quadratic fit using model 3.33, which involves P_2 and SIZ_1 as the profitability and size measures, shows evidence of a curvilinear relationship in the years 1970 and 1977 [see Table 3.1(i)]. $SIZSQ_1$ has the expected negative sign. It is, however, significant at only the .10 level in the year 1970. Even these two regressions yield poor goodness-of-fit statistics. Comparison using $\bar{R}^2$'s shows only marginal improvements in explanatory power over the linear and semi-logarithmic specifications, models 3.13 and 3.23, even in these two years.

3.7 REGRESSION RESULTS : TIME-SERIES

The procedure adopted is to fit the linear, semi-logarithmic, and quadratic specifications to the data of each firm in the sample. They are then compared on the basis of the $\bar{R}^2$'s and the model showing the highest $\bar{R}^2$ is taken as the best fit.

The results are presented in Tables 3.2(a) to 3.2(c). Table 3.2(a) summarizes the results obtained by using models 3.11, 3.21 and 3.31 which involve the variables P_1, SIZ_1, $SIZSQ_1$ and LOG SIZ_1. It can be seen that the Durbin-Watson

test for auto-correlation fell in the inconclusive region in only a few cases. It can also be seen that the model providing the best fit differs from case to case. The linear specification, model 3.11, provides the best fit in eleven cases. The t-test shows that the coefficient of size (SIZ_1) is significant in six regressions. SIZ_1 is positive in four of the six regressions and negative in two. However, the F-statistic is significant in two regressions only, viz. Ranbaxy and Cynamid. The $\bar{R}^2$'s are also high in these two regressions.

The semi-logarithmic specification, model 3.21, involving P_1 and LOG SIZ_1, is seen to be the better fit in eighteen cases. The size coefficient is significant in fifteen regressions, being negative in sign in twelve of them. The F-statistic is significant in eleven cases. The $\bar{R}^2$'s are high in a number of regressions, the highest being 0.857 in the case of Geoffrey Manners. Given that sales turnover and consequently LOG SIZ_1 increased over the time-period it seems P_1 declined over the period in a number of cases, judging by the negative coefficients of LOG SIZ_1. Quantitatively speaking size appears to be important in some of these cases. If size were doubled for instance P_1 would decrease by 1.3 percentage points in the case of Geoffrey Manners, by 2.1 percentage points in the case of Pfizer and so on. In the cases of Cadilla and Curewel where LOG SIZ_1 is positive such an increase in size would result in an increase in P_1 by 3.2 percentage

points and by 3.6 percentage points respectively. These two young companies (incorporated in the time-period) may be just realizing various scale economies while the larger firms may have exhausted theirs.

The quadratic fit, model 3.31 is best in nine cases only. The quadratic term [$SIZSQ_1$] carries the expected negative sign and is significant in two regressions. It is however positive and significant in six other regressions. The F-statistic is significant in seven regressions. The $\bar{R}^2$'s are also high in these cases. In a few cases, where $SIZSQ_1$ is positive, it seems P_1 declined initially before improving probably reflecting the benefits from the introduction of a new product or of successful diversification.

Table 3.2(b) presents the results of the regressions obtained by using models 3.12, 3.22 and 3.32 which involve the variables P_2, SIZ_2, $SIZSQ_2$ and LOG SIZ_2. Again the specification providing the best fit differs from case to case. In fourteen cases the linear specification, model 3.12, provides the best fit. However, SIZ_2 is significant in six regressions only, in four of which SIZ_2 is positive in sign. The F-statistic is significant in all six regressions. Recorded $\bar{R}^2$ is highest at 0.884 for the regression involving Cadilla. The semi-log specification, model 3.22, proves the better fit in nine cases. LOG SIZ_2 is positive in sign and significant in four regressions and negative in sign and significant in three regressions. However, the F-statistic is significant in

four regressions only. The $\bar{R}^2$'s are modest, the highest registered being 0.449 in the regression involving Bayer. The quadratic specification, model 3.23, is best in fifteen cases. The quadratic size term is significant in twelve cases and carries the expected negative sign in eight of these regressions. The $\bar{R}^2$'s show that this model has done well in the case of a few firms such as Standard Pharmaceuticals, Merck Sharpe and Dohme, Ranbaxy, Burroughs Wellcome etc.,explaining over 50% of the variation in profitability. A comparison with the results presented earlier in Table 3.2(a) shows that it is not necessarily the same specification [linear, semi-logarithmic or quadratic] that provides the best fit in individual cases. Neither is the direction of the relationship between profitability and size necessarily the same. The best fit often differs depending on the measure of profitability and size used.

Table 3.2(c) presents the results obtained by using models 3.13, 3.23 and 3.33 involving P_2, SIZ_1, $SIZSQ_1$ and LOG SIZ_1. The linear fit using model 3.13 is found to be best in eighteen cases. SIZ_1 is found to be significant in ten regressions. It is positive in eight of these ten regressions. The F-statistic is found to be significant in eight regressions. The $\bar{R}^2$'s are reasonably high in these cases with the highest being 0.867 in the regression involving Cadilla.

The semi-logarithmic fit using model 3.23 is best in eight cases. LOG SIZ_1 is significant in four regressions and is positive in sign in three of them. The F-statistic is also significant in three regressions only. The highest $\bar{R}^2$ obtained is 0.690 in the case of Burroughs Wellcome.
The quadratic fit using model 3.33 is best in twelve cases and $SIZSQ_1$ is significant in all twelve cases. These results, however, are mixed with $SIZSQ_1$ being positive in six cases and negative in the other six. The F-statistic is significant in eight of these regressions. The $\bar{R}^2$'s are also reasonably high in these eight regressions.
Comparison with the results presented earlier in Tables 3.2(a) and 3.2(b) demonstrates again that the specification providing the best fit is not necessarily the same when either the profitability measure or the size measure or both are changed.

3.8 CONCLUDING REMARKS

The analysis using cross-section data could not detect any systematic relationship between profitability and size. The linear specification, model 3.12, in which profitability on total assets is the dependent variable and total assets is the explanatory size variable, gave some indication of a negative relationship between profitability and size. Subsequent analysis pointed to the possibility of a negative bias

in the estimates. The semi-logarithmic specification also did not indicate the presence of any systematic relationship. In a few regressions, the quadratic specification revealed the presence of a curvi-linear relationship. However, it was seen that the explanatory power of this model was not much superior to the other models. Quantitatively also size was not seen to make a big difference on profitability.

The reason for the inability to find a systematic relationship between profitability and size was provided in the analysis using time-series data. Although size was found to be a significant variable in the case of a number of individual firms there was no consistency in the relationship. The relationship took different forms in different cases. The model providing the best fit was liable to change depending on the measure of profitability and size used. Thus when the relationship was studied across firms using particular models the data refused to conform consistently to any particular model.

The results of this section of the study are thus at variance with Narayana [1984] and are closer to the Hathi Committee report in not finding any systematic relationship. The results may also be termed to be close to Ramachandran [1980] in the sense that his study also failed to detect a consistent relationship between different samples.

Table 3.1(a)

Regression Results (Cross-section) : Model 3.11

Year	N	Intercept	$SIZ_1 \times 10^{-8}$	$\bar{R}^2$	F	DW	B-P statistic
1970	34	-0.013 (-0.186)	0.015 (0.256)	-0.029	0.065	2.129*	0.943
1972	37	0.046 (3.617)	-0.005 (-0.701)	-0.014	0.492	1.909*	3.186
1974	36	0.030 (2.623)	0.0002 (0.040)	-0.029	0.001	2.102*	0.681
1977	37	0.036 (4.294)	-0.0001 (-0.017)	-0.028	0.0003	1.699*	1.992
1979	38	0.035 (4.309)	-0.0002 (-0.102)	-0.027	0.010	2.011*	1.187
1981	38	0.018 (1.227)	-0.001 (-0.371)	-0.023	0.137	1.407*	0.004
1983	33	0.036 (2.758)	-0.003 (-1.304)	0.021	1.701	1.708*	12.335*
	(a)	0.037 (1.698)	-0.003 (-1.426)***	0.031	2.034	1.750*	

(a) - weighted least squares estimates ; t-values are presented within parenthesis

* - significant at the .01 level ; *** - significant at the .10 level

Table 3.1(b)

Regression Results (Cross-section): Model 3.12

Year	N	Intercept	$SIZ_2 \times 10^{-8}$	$\bar{R}^2$	F	DW	B-P statistic
1970	34	0.098 (9.705)	-0.017 (-2.641)*	0.149	6.976**	1.541*	0.785
1972	37	0.090 (10.085)	-0.007 (-1.580)***	0.039	2.498	1.989*	0.519
1974	36	0.089 (6.975)	-0.006 (-1.027)	0.001	1.055	2.580*	1.686
1977	37	0.090 (9.445)	-0.0001 (-0.032)	-0.028	0.001	1.996*	1.758
1979	38	0.103 (11.279)	-0.003 (-1.296)	0.018	1.680	2.200*	1.203
1981	38	0.111 (10.704)	-0.005 (-2.387)**	0.115	5.700**	2.072*	0.564
1983	33	0.119 (8.619)	-0.004 (-2.059)**	0.091	4.239**	1.788*	1.053

t-values are presented within parenthesis ; * - significant at the .01 level
** - significant at the .05 level ; *** - significant at the .10 level

Table 3.1(c)

Regression Results (Cross-section): Model 3.13

Year	N	Intercept	$SIZ_1 \times 10^{-8}$	$\bar{R}^2$	F	DW	B-P statistic
1970	34	0.086 (6.957)	0.002 (0.220)	-0.029	0.048	2.063*	0.317
1972	37	0.083 (7.824)	0.001 (0.071)	-0.028	0.005	1.980*	0.100
1974	36	0.081 (5.632)	0.001 (0.208)	-0.028	0.043	2.420*	3.110
1977	37	0.088 (8.928)	0.001 (0.353)	-0.024	0.124	2.002*	1.870
1979	38	0.099 (9.481)	-0.001 (-0.325)	-0.024	0.106	2.044*	1.899
1981	38	0.100 (8.256)	-0.001 (-0.236)	-0.026	0.055	1.806*	0.993
1983	33	0.110 (6.296)	-0.001 (-0.516)	-0.023	0.266	1.604*	0.094

t-values are presented within parenthesis

* - significant at .01 level

Table 3.1(d)

Regression Results (Cross-section): Model 3.21

Year	N	Intercept	LOG SIZ_1	$\bar{R}^2$	F	DW	3-P Statistic
1970	34	-0.072 (-0.074)	0.009 (0.072)	-0.031	0.005	2.122*	0.460
1972	37	0.066 (0.431)	-0.003 (-0.170)	-0.027	0.029	1.970*	3.197
1974	36	-0.002 (-0.029)	0.004 (0.410)	-0.024	0.168	2.117*	0.181
1977	37	0.025 (0.215)	0.001 (0.095)	-0.028	0.009	1.696*	21.466*
	(a)	0.014 (0.123)	0.002 (0.197)	-0.027	0.038	1.730*	
1979	38	-0.006 (-0.062)	0.005 (0.383)	-0.023	0.146	2.023*	0.234
1981	38	-0.039 (-0.187)	0.006 (0.261)	-0.021	0.068	1.397*	0.883
1983	33	-0.002 (-0.016)	0.003 (0.154)	-0.031	0.023	1.769*	4.100

(a) weighted least square estimates

t-values are presented within parenthesis

* - significant at .01 level

Table 3.1(e)

Regression Results (Cross-section): Model 3.22

Year	N	Intercept	LOG SIZ_2	$\bar{R}^2$	F	D.W	B-P Statistic
1970	34	0.089 (0.605)	-0.001 (-0.025)	-0.030	0.001	1.910*	3.879
1972	37	0.083 (0.632)	0.0001 (0.005)	-0.028	0.0002	1.972*	0.005
1974	36	0.045 (0.381)	0.004 (0.317)	-0.026	0.100	2.426*	1.415
1977	37	-0.064 (-0.456)	0.019 (1.094)	0.005	1.197	2.023*	6.750
1979	38	0.161 (1.151)	-0.007 (-0.455)	-0.021	0.207	2.055*	1.548
1981	38	0.249 (1.564)	-0.018 (-0.946)	-0.002	0.896	1.872*	0.630
1983	33	0.182 (0.865)	-0.009 (-0.370)	-0.027	0.137	1.644*	0.113

t-values are presented within parenthesis ; * - significant at .01 level

Table 3.1(f)

Regression Results (Cross-section): Model 3.23

Year	N	Intercept	LOG SIZ_1	$\bar{R}^2$	F	DW	B-P Statistic
1970	34	-0.107 (-0.648)	0.025 (1.184)	0.012	1.403	2.224*	0.950
1972	37	0.020 (0.158)	0.008 (0.498)	-0.021	0.248	2.037*	0.207
1974	36	-0.014 (-0.142)	0.012 (0.981)	-0.001	0.964	2.467*	0.375
1977	37	-0.118 (-0.902)	0.025 (1.592)***	0.040	2.536	2.046*	0.309*
	(a)	-0.107 (-0.833)	0.024 (1.540)***	0.036	2.372	2.048*	
1979	38	0.018 (0.136)	0.009 (0.564)	-0.018	0.318	2.121*	0.939
1981	38	-0.019 (-0.120)	0.014 (0.725)	-0.012	0.525	1.831*	0.448
1983	33	-0.065 (-0.289)	0.020 (0.749)	-0.013	0.562	1.654*	0.180

(a) - weighted least square estimates ; t- values are presented within parenthesis

* - significant at .01 level ; *** - significant at .10 level

Table 3.1(g)

Regression Results (Cross-section) : Model 3.31

Year	N	Intercept	$SIZ_1 \times 10^{-8}$	$SIZSQ_1$	$\bar{R}^2$	F	DW	B-P Statistic
1970	34	-0.024 (-0.252)	0.044 (0.251)	-0.007 (-0.173)	-0.061	0.046	2.121*	1.337
1972	37	0.043 (2.635)	-0.001 (-0.071)	-0.001 (-0.206)	-0.022	0.260	1.893*	11.043*
	(a)	0.059 (1.918)	-0.017 (-0.681)	0.001 (0.414)	-0.015	0.731	1.917*	
1974	36	0.026 (1.719)	0.005 (0.346)	-0.001 (-0.358)	-0.056	0.065	2.094*	0.885
1977	37	0.025 (2.264)	0.010 *** (1.453)	-0.001 *** (-1.578)	0.013	1.247	1.621*	12.081*
	(a)	0.018 (2.187)	0.013 (4.038)*	-0.001 (-5.123)*	0.523	20.777*	2.058*	
1979	38	0.029 (2.721)	0.004 (0.740)	-0.0004 (-0.838)	-0.036	0.356	1.945*	1.641
1981	38	0.021 (0.987)	-0.002 (-0.286)	0.0001 (0.164)	-0.052	0.080	1.419*	1.794
1983	33	0.039 (1.571)	-0.001 (-0.167)	-0.0001 (-0.251)	-0.001	0.979	1.885*	14.254*
	(a)	0.082 (2.304)	-0.017 (-1.866)**	0.001 (1.569)***	0.075	2.297	1.819*	

(a) - weighted least square estimates ; t-values are presented within parenthesis
* - significant at .01 level ; ** - significant at .05 level ; *** - significant at .10 level

Table 3.1(h)

Regression Results (Cross-section): Model 3.32

Year	N	Intercept	$SIZ_2 \times 10^{-8}$	$SIZSQ_2$	$\bar{R}^2$	F	DW	B-P Statistic
1970	34	0.083 (6.534)	0.019 (0.965)	-0.005 (-1.909)**	0.212	5.591*	1.806*	1.648
1972	37	0.080 (6.798)	0.012 (0.836)	-0.002 (-1.392)***	0.065	2.252	2.183*	0.839
1974	36	0.085 (4.946)	0.001 (0.049)	-0.001 (-0.401)	-0.023	0.595	2.625*	3.186
1977	37	0.082 (6.730)	0.009 (0.906)	-0.001 (-0.967)	-0.030	0.468	2.106*	2.843
1979	38	0.102 (8.313)	-0.002 (-0.336)	-0.0001 (-0.099)	-0.009	0.822	2.220*	1.558
1981	38	0.110 (8.102)	-0.005 (-0.747)	0.0001 (0.0001)	0.091	2.852	2.087*	0.537
1983	33	0.116 (6.238)	-0.002 (-0.413)	-0.0001 (-0.258)	0.063	2.089	1.804*	1.130

t-values are presented within parenthesis ; * - significant at .01 level

** - significant at .05 level ; *** - significant at .10 level

Table 3.1(i)

Regression Results (Cross-section) : Model 3.33

Year	N	Intercept	$SIZ_1 \times 10^{-8}$	$SIZSQ_1$	$\bar{R}^2$	F	DW	B-P Statistic
1970	34	0.071 (4.346)	0.041 (1.395)***	-0.009 (-1.407)***	0.001	1.015	2.273*	1.287
1972	37	0.076 (5.550)	0.013 (0.728)	-0.002 (-0.758)	-0.041	0.289	1.943*	0.425
1974	36	0.079 (4.109)	0.003 (0.191)	-0.0003 (-0.121)	-0.058	0.028	2.418*	5.132
1977	37	0.071 (5.841)	0.016 (2.088)**	-0.001 (-2.103)**	0.066	2.280	1.862*	8.588
1979	38	0.093 (6.717)	0.003 (0.512)	-0.0004 (-0.681)	-0.040	0.284	2.014*	2.469
1981	38	0.100 (5.876)	-0.001 (-0.087)	0.000 (0.000)	-0.055	0.027	1.806*	1.224
1983	33	0.101 (3.858)	0.002 (0.293)	-0.0003 (-0.476)	-0.049	0.243	1.577*	0.560

t-values are presented within parenthesis ; * - significant at .01 level

** - significant at .05 level ; *** - significant at .10 level

Table 3.2(a)

Regression Results (Time-series): Models 3.11,3.21,3.31

Company	N	Intercept	$SIZ_1 \times 10^{-8}$	$SIZSQ_1$	$LOGSIZ_1$	$\bar{R}^2$	F	DW
Duphar Interfran	14	0.134 (1.032)			-0.013 (-0.764)	-0.033	0.584	1.022
Glaxo Laboratories	14	0.039 (3.165)	0.003 (0.898)	-0.0002 (-1.072)		-0.008	0.949	1.019
Boehringer Knoll	14	0.059 (2.699)	-0.054 (-2.016)**			0.191	4.066	2.361*
Amrutanjan	14	0.142 (1.813)			-0.016 (-1.500)***	0.088	2.250	1.821*
Rallis	13	0.010 (2.724)	-0.0001 (-0.180)			-0.080	0.032	1.759*
Searle	14	0.438 (1.777)			-0.045 (-1.385)***	0.066	1.917	1.510*
Unichem Laboratories	14	0.249 (5.438)			-0.028 (-4.963)*	0.645	24.636*	1.586*
Warner Hindusthan	14	0.456 (8.065)			-0.050 (-7.095)*	0.792	50.343*	1.797*
Reckitt and Colman	13	0.038 (6.266)	0.005 (1.474)***			0.083	2.172	1.139*
Standard Pharmaceuticals	13	0.671 (2.530)			-0.083 (-2.473)**	0.299	6.117**	1.855*

Company	N	Intercept	$SIZ_1 \times 10^{-8}$	$SIZSQ_1$	$LOGSIZ_1$	$\bar{R}^2$	F	DW
Pfizer	14	0.669 (5.043)			-0.071 (-4.566)*	0.604	20.648*	1.341*
Boots	14	0.186 (3.756)			-0.018 (-2.897)*	0.362	8.392**	1.090*
Chemopharma	13	0.086 (1.691)	-0.562 (-2.092)**	0.646 (2.236)**		0.214	2.637	2.139*
Alembic	13	0.025 (2.316)	-0.0002 (-0.073)			-0.083	0.005	1.692*
Cadilla Laboratories	8	-0.826 (-3.629)			0.107 (3.272)*	0.493	10.708*	2.453*
Richardson Hindusthan	14	0.087 (5.508)	-0.079 (-2.812)*	0.026 (2.440)**		0.383	5.036**	0.946
Cipla	14	-0.142 (-1.264)			0.021 (1.437)***	0.076	2.065	2.558*
Nila Products	13	-0.117 (-1.547)	1.419 (1.497)***			0.101	2.240	1.679*
Ranbaxy Laboratories	14	0.027 (9.956)	0.009 (5.815)*			0.716	33.812*	2.246*
Sandoz Laboratories	14	0.156 (4.008)			-0.015 (-3.219)*	0.419	10.360*	1.517*

contd ...

Company	N	Intercept	$SIZ_1 \times 10^{-8}$	$SIZSQ_1$	$LOGSIZ_1$	$\bar{R}^2$	F	DW
German Remedies	14	0.065 (1.450)			-0.003 (-0.544)	-0.057	0.296	1.654*
Bayer	14	1.131 (8.601)			-0.125 (-8.079)*	0.831	65.282*	1.913*
J.L. Morrison	14	-0.420 (-1.893)			0.057 (1.968)**	0.181	3.873	1.302*
Albert David	14	-0.010 (-0.573)	0.058 (1.692)***			0.125	2.866	1.971*
Geoffrey Manners	13	0.406 (9.298)			-0.044 (-8.566)*	0.857	73.377*	1.679*
Cynamid	12	0.177 (5.405)	-0.055 (-3.228)*			0. 461	10.423*	1.002
Infar	13	0.107 (6.603)	-0.171 (-3.816)*	0.112 (4.521)*		0.672	13.293*	2.161*
Hoechst	14	0.192 (6.741)	-0.062 (-4.324)*	0.005 (3.941)*		0.586	10.217*	1.177
Parke Davies	14	1.085 (3.353)			-0.126 (-3.182)*	0.412	10.130*	2.421*
Ciba Geigy	13	0.026 (2.573)	0.009 (2.189)**	-0.0007 (-1.627)***		0.422	5.396**	1.464*
Roche	14	0.720 (3.553)			-0.082 (-3.275)*	0.428	10.729*	2.044*

contd ...

Company	N	Intercept	$SIZ_1 \times 10^{-8}$	$SIZSQ_1$	$LOGSIZ_1$	$\bar{R}^2$	F	DW
E.Merck	14	0.026 (2.320)	-0.017 (-0.818)	0.012 (1.448)***		0.310	3.923**	1.668*
Roussel	14	0.051 (2.710)	-0.004 (-0.203)			-0.079	0.041	2.329*
Hindusthan Antibiotics	14	-0.108 (-1.234)	-0.016 (-0.328)			-0.073	0.108	0.933
IDPL	14	-1.235 (-4.860)	0.396 (3.874)*	-0.028 (-3.365)*		0.547	8.874*	1.195
Merck Sharpe Dohme	13	0.231 (5.142)	-0.289 (-3.818)*	0.094 (3.141)*		0.761	20.189*	2.778*
Burroughs Wellcome	14	0.039 (6.665)	0.001 (0.560)			-0.055	0.313	1.116*
Curewel	10	-0.772 (-0.888)			0.122 (0.966)	-0.007	0.934	1.215*

t-values are presented within parenthesis ; * - significant at .01 level

** - significant at .05 level ; *** - significant at .10 level

Table 3.2(b)

Regression Results (Time-series): Models 3.12,3.22,3.32

Company	N	Intercept	$SIZ_2 \times 10^{-8}$	$SIZSQ_2$	LOG SIZ_2	$\bar{R}^2$	F	DW
Duphar Interfran	14	0.091 (6.245)	0.013 (0.387)			-0.069	0.150	1.844*
Glaxo Laboratories	14	0.042 (2.881)	0.017 (2.755)*	-0.001 (-2.323)**		0.425	5.822**	1.870*
Boehringer Knoll	14	0.099 (2.842)	-0.029 (-0.439)			-0.066	0.193	2.430*
Amrutanjan	14	0.061 (4.739)	0.069 (1.198)			0.032	1.435	1.589*
Rallis	13	-0.329 (-1.515)			0.047 (1.906)**	0.168	3.635	3.249*
Searle	14	0.155 (7.783)	0.027 (0.668)			-0.044	0.446	1.907*
Unichem Laboratories	14	-0.399 (-2.811)			0.062 (3.427)*	0.452	11.750*	1.770*
Warner Hindusthan	14	0.114 (10.033)	0.011 (0.627)			-0.048	0.393	1.251*
Reckitt and Colman	13	-0.685 (-1.333)	1.621 (1.601)***	-0.672 (-1.527)***		0.050	1.348	2.306*
Standard Pharmaceuticals	13	0.267 (5.235)	-0.738 (-4.107)*	0.507 (3.675)*		0.598	9.957*	1.928*

contd ...

Company	N	Intercept	$SIZ_2 \times 10^{-8}$	$SIZSQ_2$	LOG SIZ_2	$\bar{R}^2$	F	DW
Pfizer	14	0.135 (10.966)	-0.015 (-3.447)*			0.455	11.887*	1.250*
Boots	14	0.111 (15.689)	-0.005 (-0.695)			-0.041	0.483	1.374*
Chemopharma	13	0.050 (1.303)	0.047 (0.478)			-0.068	0.228	2.026*
Alembic	13	0.042 (1.943)	0.025 (2.413)**			0.270	5.826**	2.057*
Cadilla Laboratories	8	-0.017 (-0.736)	0.262 (8.791)*			0.884	77.286*	2.033*
Richardson Hindusthan	14	0.113 (2.582)	-0.113 (-0.846)	0.119 (1.298)		0.443	6.171**	0.848
Cipla	14	-0.131 (-0.681)			0.027 (1.045)	0.007	1.093	2.310*
Nila Products	13	0.461 (1.024)	-14.957 (-1.001)	131.993 (1.086)		0.006	1.040	1.005
Ranbaxy Laboratories	14	0.069 (6.684)	0.067 (3.817)*	-0.015 (-3.347)*		0.511	7.819*	2.028*
Sandoz Laboratories	14	0.044 (1.947)	0.054 (2.426)**	-0.011 (-2.555)**		0.271	3.416	1.948*

contd ...

Company	N	Intercept	$SIZ_2 \times 10^{-8}$	$SIZSQ_2$	LOG SIZ_2	$\bar{R}^2$	F	D.W
German Remedies	14	0.100 (13.061)	0.019 (2.713)*			0.328	7.363**	1.249*
Bayer	14	0.817 (4.045)			-0.082 (-3.405)*	0.449	11.597*	2.023*
J.L. Morrison	14	-0.656 (-1.950)			0.098 (2.169)**	0.221	4.705**	1.371*
Albert David	14	-0.024 (-0.597)	0.323 (2.359)**			0.260	5.568**	1.320*
Geoffrey Manners	13	0.128 (10.629)	-0.046 (-3.289)*			0.450	10.822*	1.966*
Cynamid	12	-0.331 (-1.832)	0.743 (2.641)**	-0.295 (-2.804)*		0.403	4.719**	1.663*
Infar	13	0.158 (3.106)	-0.270 (1.518)***	0.256 (1.814)**		0.241	2.910	1.388*
Hoechst	14	0.272 (4.487)	-0.117 (-2.445)**	0.021 (2.593)**		0.280	3.536	1.029
Parke Davies	14	1.396 (1.651)			-0.162 (-1.504)***	0.088	2.265	2.364*
Ciba Geigy	13	-0.003 (-0.110)	0.073 (3.086)*	-0.009 (-2.753)*		0.449	5.902**	1.847*
Roche	14	0.020 (0.254)	0.179 (1.022)	-0.099 (-1.138)		0.007	1.047	2.021*
E.Merck	14	-0.249 (-1.807)			0.044 (2.494)**	0.286	6.220**	1.229*

contd ..

Company	N	Intercept	$SIZ_2 \times 10^{-8}$	$SIZSQ_2$	LOG SIZ_2	$\bar{R}^2$	F	DW
Roussel	14	-0.0186 (-0.044)			0.020 (0.365)	-0.071	0.133	2.301*
Hindusthan Antibiotics	14	-0.041 (-1.223)	0.002 (0.287)			-0.075	0.082	0.859
IDPL	14	-0.259 (-3.238)	0.035 (3.577)*	-0.001 (-3.702)*		0.481	7.043*	0.796
Merck Sharpe Dohme	13	0.346 (7.387)	-0.642 (-4.587)*	0.392 (3.980)*		0.763	20.348*	2.063*
Burroughs Wellcome	14	0.034 (4.169)	0.042 (2.894)*	-0.009 (-2.034)**		0.636	12.367*	2.647*
Curewel	10	1.633 (2.172)			-0.216 (-2.057)**	0.264	4.231	2.203*

t-values are presented within parenthesis ; * - significant at .01 level
** - significant at .05 level ; *** - significant at .10 level

Table 3.2(c)

Regression Results (Time-series): Models 3.13,3.23,3.33

Company	N	Intercept	$SIZ_1 \times 10^{-8}$	$SIZSQ_1$	LOG SIZ_1	$\bar{R}^2$	F	DW
Duphar Interfran	14	-0.113 (-0.509)			0.027 (0.941)	-0.008	0.886	1.834*
Glaxo Laboratories	14	0.040 (3.084)	0.012 (3.254)*	-0.001 (-2.765)*		0.525	8.209*	1.724*
Boehringer Knoll	14	0.041 (0.108)			0.005 (0.111)	-0.082	0.012	2.337*
Amrutanjan	14	0.059 (5.283)	0.041 (1.591)***			0.105	2.534	1.645*
Rallis	13	-0.290 (-1.570)			0.041 (2.032)**	0.194	4.129	3.172*
Searle	14	0.154 (8.712)	0.024 (0.860)			-0.020	0.740	1.920*
Unichem Laboratories	14	0.064) (11.202)	0.020 (4.444)*			0.590	19.751*	1.771*
Warner Hindusthan	14	0.112 (18.263)	0.007 (1.692)***			0.125	2.363	1.372*
Reckitt and Colman	13	-0.386 (-1.191)	0.693 (1.592)***	-0.176 (-1.461)***		0.066	1.461	2.315*
Standard Pharmaceuticals	13	0.239 (4.868)	-0.410 (-3.726)*	0.175 (3.337)*		0.545	8.214*	1.715*

contd ...

Company	N	Intercept	$SIZ_1 \times 10^{-8}$	$SIZSQ_1$	LOG SIZ_1	$\bar{R}^2$	F	DW
Pfizer Laboratories	14	0.129 (8.610)	-0.008 (-2.361)**			0.260	5.574**	1.102*
Boots	14	0.110 (18.186)	-0.001 (-0.523)			-0.059	0.273	1.392*
Chemopharma	13	0.123 (2.714)	-0.434 (-1.797)**	0.536 (2.062)**		0.238	2.821	2.235*
Alembic	13	0.046 (3.073)	0.015 (3.342)*			0.439	11.175*	2.245*
Cadilla Laboratories	8	-0.017 (-0.503)	0.144 (6.830)*			0.867	46.660*	2.893*
Richardson Hindusthan	14	0.068 (6.889)	0.025 (3.370)*			0.443	11.357*	0.887
Cipla	14	-0.155 (-0.801)			0.029 (1.163)	0.026	1.353	2.323*
Nila Products	13	0.003 (0.054)	0.776 (0.949)			-0.008	0.901	0.869
Ranbaxy Laboratories	14	0.065 (6.897)	0.065* (4.253)	-0.014 (-3.513)*		0.616	11.467*	2.068*
Sandoz Laboratories	14	0.059 (3.681)	0.024 (2.268)**	-0.003 (-2.164)**		0.199	2.620	2.042*
German Remedies	14	0.099 (15.665)	0.013 (3.532)*			0.468	12.475*	1.412*

contd ...

Company	N	Intercept	$SIZ_1 \times 10^{-8}$	$SIZSQ_1$	LOG SIZ_1	$\bar{R}^2$	F	DW
Bayer	14	0.645 (4.056)			-0.060 (-3.243)*	0.422	10.520*	2.061*
J.L. Morrison	14	0.044 (1.798)	0.061 (1.267)			0.044	1.606	1.002
Albert David	14	-0.019 (-0.621)	0.173 (3.047)*			0.389	9.289*	1.669*
Geoffrey Manners	13	0.117 (14.011)	-0.011 (-3.482)*			0.481	12.128*	2.172*
Cynamid	12	0.129 (2.420)	-0.013 (-0.488)			-0.074	0.238	1.005
Infar	13	0.101 (5.147)	-0.051 (-0.950)	0.056 (1.862)**		0.556	8.513*	1.450*
Hoechst	14	0.243 (6.696)	-0.060 (-3.278)*	0.006 (3.400)*		0.424	5.802**	1.109
Parke Davies	14	0.321 (3.388)	-0.241 (-1.969)**	0.063 (1.784)**		0.169	2.323	2.572*
Ciba Geigy	13	0.022 (0.932)	0.033 (3.229)*	-0.002 (-2.552)**		0.582	9.376*	1.776*
Roche	14	0.102 (5.252)	-0.010 (-0.775)			-0.031	0.601	1.854*
E. Merck	14	-0.270 (-2.135)			-0.046 (2.884)*	0.360	8.320**	1.078*
Roussel	14	-0.022 (-0.054)			0.020 (0.377)	-0.070	0.142	2.310*

contd ...

Company	N	Intercept	$SIZ_1 \times 10^{-8}$	$SIZSQ_1$	LOG SIZ_1	$\bar{R}^2$	F	DW
Hindusthan Antibiotics	14	-0.052 (-1.250)	0.012 (0.515)			-0.059	0.265	0.833
IDPL	14	-0.093 (-4.018)	0.046 (4.956)*	-0.003 (-4.685)*		0.637	12.424*	1.207
Merck Sharpe Dohme	13	0.365 (4.972)	-0.413 (-3.340)*	0.151 (3.065)*		0.519	7.473*	2.174*
Burroughs Wellcome	14	-0.224 (-4.228)			0.036 (5.478)*	0.690	30.016*	2.405*
Curewel	10	0.077 (1.705)	0.125 (0.226)			-0.117	0.051	1.477*

t- values are presented within parenthesis ; * - significant at .01 level
** - significant at .05 level ; *** - significant at .10 level

CHAPTER 4

PROFITABILITY AND DIVERSIFICATION

4.1 INTRODUCTION

Over the years the firms operating in the pharmaceutical industry have been steadily diversifying. An NCAER study of the annual reports of thirty-three pharmaceutical units between the years 1977-78 to 1980-81 says "A scrutiny of the balance-sheets in the private organized sector manufacturing pharmaceuticals showed that some have diversified into non-drug production. In the case of some the contribution of non-drug activity formed a substantial portion of their annual sales" [Narayana 1984, p. 207]. Their study showed that sales turnover from non-pharmaceutical activity increased fastest over the period in comparison to the sales turnover of bulk drugs and pharmaceutical formulations. This can be seen in Table 4.1(a). The sales turnover from non-pharmaceutical activity increased by 98.08% while the sales turnover from bulk drugs and pharmaceutical formulations increased by 61.4% and 67.3% respectively. Sales turnover from non-pharmaceutical activity which constitued 8.3% of total sales turnover in 1977-78 increased to 9.7% in 1981-82. Over the same period the proportion of sales turnover from pharmaceutical formulations declined by a percentage point. The proportion of sales

turnover from bulk drugs also registered a marginal decline. Commenting on the decrease in the contribution of pharmaceutical activity to total sales turnover the study says "It is possible that these units perhaps consciously reduced the production of pharmaceutical products" [Narayana 1984, p.207].

The sample in this study also contains a number of well diversified pharmaceutical firms such as Glaxo Laboratories, Reckitt and Colman, Sandoz, Bayer, J.L. Morrison, Rallis etc. An examination of the sales composition of 35 firms in our sample for whom data is available for the same period as the NCAER study is presented in Table 4.1(b). The results are slightly different because the composition of our sample is not the same as the NCAER study. Not only does our sample contain some larger and more diversified firms it also includes two large public sector enterprises. The table shows that sales revenue from bulk drugs formed only 8.12% of the total sales turnover in 1977. The corresponding figures for pharmaceutical formulations and non-pharmaceuticals are 58.78% and 33.10% respectively. It is evident that non-pharmaceutical production constitues a significant activity of pharmaceutical firms. It can be seen that the turnover from the sale of bulk drugs and intermediates has dropped to 6.78% of total sales turnover in the year 1981. The contribution from pharmaceutical formulations is also down marginally to 58.35%. On the other hand, the sales turnover from non-pharmaceutical

activity has increased to 34.86% of total sales turnover. Sales of non-pharmaceuticals also grew fastest at 67.39%. The corresponding growth rates of the sales of bulk drugs and formulations are 33% and 58.25% respectively. These figures while differing from the NCAER study however agree that many firms in the industry were steadily diversifying and increasingly turning their attention to non-pharmaceutical activity.

4.2 TRENDS IN DIVERSIFICATION

The nature of diversification undertaken by most pharmaceutical firms may be termed as one of product extension. Product extension essentially means that the products do not compete directly with one another but are still related in either production or distribution. Thus we have firms which are diversified into pharmaceutical formulations, bulk drugs and intermediates, cosmetics and toileteries, pesticides and weedicides, and foodstuffs such as protein foods, feed supplements and infant foods. For instance, Glaxo Laboratories is diversified into basic drugs and intermediates, pharmaceutical formulations, feed supplements etc., and Reckitt and Colman produces drug intermediates, pharmaceutical formulations, foodstuffs, polishes, detergent, cosmetics and toileteries. Sandoz produces basic drugs, formulations, dyes and agrochemicals. The diversification is mostly into related industries at the three-digit level. However, there are some firms, few

in number, which have diversified into unrelated industries at the two-digit level such as Rallis and Albert David. Rallis produces in a whole range of unrelated product categories such as fertilizers, engineering goods, marine products etc.,besides pharmaceutical products. Similarly, Albert David produces pharmaceuticals and paper products. But such examples are few. Mainly, the firms are diversified within the same two-digit industry. Under the revised Industrial Classification Codes the manufacture of chemical products is assigned the code 3.8 at the two-digit level. The sub-industries classified under this two digit industry are medical and pharmaceutical preparations (code 3.80 at the three-digit level), soaps and cleaning Compounds (3.82), paints and varnishes (3.84), pesticides (3.89) and so on. The propensity to diversify into related product categories has also been noticed by Bajpai [1985]. To quote "Companies in the Chemical Industry showed the least preference for unrelated diversification" [Bajpai 1985, p. 105].

4.3 DETERMINANTS OF DIVERSIFICATION

Theories explaining the process of diversification are few. In this context a general explanation for the process of diversification can be said to have been given by Penrose [1959] and Marris [1964]. To Penrose the firm is a collection of productive resources both physical and human which are

worth more to the firm than their market value because of the experience gained by resources in the firm. As existing activities become familiar and routine, some of the resources become either underutilized or remain unutilized. Unutilized and/or underutilized managerial resources then search for new activities that will make use of their capabilities. Such an underutilized resource could be a certain technical expertise or knowledge within the firm. Since the opportunity cost of these resources is close to zero they can be exploited to generate additional revenue for the firm [Wolf 1977]. Penrose, however, did not provide a convincing motivation for the reduction of managerial slack. Marris [1964] filled this gap by arguing that the threat of takeovers and other forms of capital market pressures are adequate to ensure managerial efficiency. Gorecki [1975] in an empirical study of the process of diversification explained that during the course of its operations a firm may come to possess some 'specific assets' which can be applied in several industries. The specific asset may be in the form of an innovation, a certain marketing skill, managerial expertise, or a certain brand image. Depending on relative profitability the firm may lease the asset to another firm or would itself diversify into industries where the specific asset can be exploited.

A particularly important reason for diversification in the Indian context is the presence of Government regulation through

the Industries (Development and Regulation) Act 1951, Monopolies and Restrictive Trade Practices Act 1969 and in the context of the pharmaceutical industry The Drug (Prices Control) Order 1970 and 1979 [Dingra 1970; Chaudhury et al. 1982]. To quote "the major reason for diversification in Indian industry seems to have been the fact that growth possibilities in existing lines of business were blocked out not by an interplay of market forces but by governmental regulation" [Chaudhury et al. 1982, p. 34] and ".... diversification in Indian industry seems to be influenced strongly by governmental regulations and public policy" [Chaudhury et al. 1982, p. 36].

Certain spinoffs from diversified production also make it attractive for a firm to diversify. The first such spinoff emanates from the presence of economies of scope [Panzar and Willig 1981; Baumol et al. 1982]. Two possible sources of economies of scope are recognized :

(a) Where a common input is required to produce more than one output. This could be a source of cost savings.

(b) Where an input(s) can be shared among several production processes. This reduces the average total costs of all products involved. This is possible if a firm uses indivisible or fixed inputs that are not specialized. Such indivisibilities may also exist in financial, marketing and managerial inputs.

Secondly, investment funds may be more cheaply obtained by diversified firms because there is less risk attached to a diversified firm's operation. There is a smaller chance that an extreme occurrence would wipe out the entire firm if it is diversified than if it were a single product firm. The well diversified firm, it is believed, would have stable profits. Thirdly, the ability to cross-subsidize by supporting other products in their stand-up phase. Such a capability becomes important in tiding over a crisis allowing the firm to stay on in a potentially lucrative line where it is currently not performing well.

Fourthly, diversification may under certain conditions enable a firm to indulge in monopolistic practices such as price discrimination and full-line forcing. Price discrimination is possible if the firm produces closely related or substitutable products. Full-line forcing on the other hand, compels a purchaser to buy a whole range of products in addition to what he is basically interested in thereby increasing total sales and consequently total profits. [For a review of these and other factors see Shepherd 1979; Koch 1980; Clarkson and Miller 1982].

In view of these spinoffs, diversification is an important firm-level structural variable determining the performance of a firm. Its influence in determining profitability and also the stability of profit rates therefore merit study.

4.4 REVIEW OF EMPIRICAL EVIDENCE

The structure-conduct-performance framework has been extensively used in studying the effect of industry diversification on industry profit rates although there has been no agreement on the findings. Studies at the firm-level are few in number and the evidence has been sketchy.

At the industry-level studies by Fuchs [1961], Miller [1969] and Rhoades [1973] found a positive relationship between diversification as a barrier to entry at the industry level and industry profitability. Jones et al. [1977] found no no evidence to support this hypothesis. Classifying the sample into consumer goods and produces goods industries Jones et al. found that the results for the consumer goods industry sample did not support the hypothesis. On the other hand, the producer goods industry sample produced results contrary to the hypothesis that the relation between profitability and diversification is positive. Studying with improved data Rhoades [1974] contradicted his earlier results by finding that diversification had a negative influence on industry profit margins. More recently, Alexander [1986] found that outbound diversification increased industry profitability while inbound diversification reduced it.

At the firm-level, Mellicher and Rush [1972] observed that conglomerate firms only achieved a level of performance comparable to non-conglomerate firms though it was by no means outstanding. Carter [1977] found support for synergistic effects of conglomerate diversification through mergers. Beattie [1980] could neither confirm nor reject the argument that conglomerate diversification resulted in superior returns performance. In a study of large food processing firms Imel and Helmberger [1971] could find no positive association between the degree of diversification and profit rates. Earlier, a similar study of food manufacturing companies in the United States had shown that a strong negative relationship existed between profitability and diversification [U.S.F.T.C. 1969]. Pomfret and Shapiro [1980] and earlier the U.S.F.T.C. [1971] reported a negative but insignificant relationship. Hartley and Watt [1981] found that diversification did not protect the overall profitability of a regulated aerospace firm [Hawker Siddeley] in the United Kingdom. On the pharmaceutical industry there has been no specific study. Mukhopadhyay [1985], however, examined two pharmaceutical firms in the Indian industry and reported a low negative correlation between profit rates and diversification. The paucity of studies examining this aspect, thus make such a study all the more desirable.

Studies examining the stability motive for diversification are also few in number. Caves [1970] had proposed that large firms may prefer stability in profits and in that context mentioned diversification as a means of achieving it. Pomfret and Shapiro [1980] while pointing out that diversification is not undertaken primarily to stabilize profits by all large firms nevertheless concede that it may result in some stability in profits. Also, to the extent that the size-diversification relationship is positive the greater stability in returns of large firms [Pomfret and Shapiro 1980; Whittington 1980] may be attributed to diversification.

The overall picture that seems to emerge is that diversification did not lead to an improvement in profit rates at the firm-level. At best it lent some stability to profit rates by maintaining them at old levels and at worst led to a decline in profitability.

4.5 THE EMPIRICAL ANALYSIS : SPECIFICATION OF THE MODELS

In order to study the relationship between profitability and diversification two separate linear regression models are proposed. The models are as follows :

$$P_1 = a + b_1 DIV + u \qquad (4.1)$$

$$P_2 = a + b_1 DIV + u \qquad (4.2)$$

where, P_1 is the ratio of net profits to total sales turnover.

P_2 is the ratio of operating profits to total assets

DIV represents the Berry's index of diversification, and

u is the random disturbance term.

The Berry's index of diversification [Berry 1975] is defined as

$DIV = 1 - \sum_{i=1}^{n} p_i^2$, where p_i represents the proportion of sales turnover of the ith product category to total sales turnover. In calculating the Berry's index of diversification the sales turnover of different products are aggregated under product-categories approximately corresponding to the three-digit categories of industrial classification. Thus some of the product-categories used for classification purposes are - Pharmaceutical formulations, Bulk drugs and intermediates, Cosmetics and Toileteries, Pesticides and Weedicides, Dyes and so on. The diversification index can thus be said to have been measured at the three-digit level. The Berry's Index of diversification is computed for every year for which data is available. But as already mentioned in the second chapter, the product structure data necessary for computing the index is available with any kind of regularity only from the mid-seventies onwards.

The sample for the study consists of thirty-six firms. As a result of the infrequent reporting of product-wise sales turnover the length of the time-series on the diversification index that could be computed varies from firm to firm. The

longest time-series favailable for any one firm is twelve years. Approximately, therefore, the study corresponds to the period 1973-83. Restrictions so that the data available for all firms correspond to a common time-period would mean shortening of the time-series and also a reduction in the sample size. Since the idea is to get a general feel for the effect of firm-level diversification on their profitability, the data available is used as such and all the firms are retained in the sample.

4.6 REGRESSION RESULTS : CROSS-SECTION

Tables 4.2(a) and 4.2(b) present the results of the analysis using cross-section data. The regressions, as the Breush-Pagan tests show, are free from the presence of heteroscedasticity. Table 4.2(a) presents the results obtained from fitting model 4.1. This model, to recollect, involves the regression of P_1 on DIV. The results indicate that diversification had a weak negative influence on profitability. The t-test shows that DIV is not significant in any regression. The goodness-of-fit statistics also point to the poor performance of the regressions. The $\bar{R}^2$'s are negative and the computed F-statistics are insignificant.

The use of model 4.2 wherein P_2 is regressed on DIV yields similar results which can be seen in Table 4.2(b). The coefficient of DIV is generally negative and just as in the previous

case is insignificant in every regression. Poor $\bar{R}^2$'s are obtained and the F-statistics are also insignificant. It is clear that the use of an alternate measure of profitability does not result in any change in the results of the cross-section analysis. It can, therefore, be said with some certainty that diversification, across firms, does not have any influence on the profitability of firms in the Indian pharmaceutical industry.

4.7 REGRESSION RESULTS : TIME-SERIES

The results of the time-series analysis are presented in Tables 4.3(a) and 4.3(b). It can be seen from Table 4.3(a) that no distinctive pattern emerges in the relationship between profitability P_1 and DIV when model 4.1 is applied. The relationship is positive in sixteen regressions and negative in twenty regressions. The t-test shows that DIV is significant in nine regressions although at different levels. In five of these regressions DIV has a positive sign and in four regressions a negative sign. The results are thus evenly distributed. The model, however, has not done well in most of the cases. The obtained F-statistics are significant in only five regressions at different levels. The $\bar{R}^2$'s indicate that more than 50% of the variation in P_1 is explained by the model in only three cases. More moderate values of $\bar{R}^2$ are obtained in a few other cases. It, therefore, seems that, except in a few

firms, diversification is not a significant determinant of profitability. However, a closer look at the cases where DIV is significant may be of interest. An examination of the time-series data on the diversification index in those cases where DIV is significant shows that the index has steadily declined over the time-period in the cases of Glaxo Laboratories, Boehringer-Knoll, Reckitt and Colman, Warner-Hindusthan, and Merck Sharpe and Dohme. The decline in the Berry's index is marginal in the case of Glaxo Laboratories and Reckitt and Colman, from 0.55 to 0.50 in the case of Glaxo and from 0.75 to 0.70 in the case of Reckitt and Colman. But profitability P_1 has risen as DIV carries a negative sign. Dropping minor product lines and concentrating production efforts on the more profitable lines of production has helped push up profitability in these cases. To give some examples Glaxo Laboratories stopped producing some cosmetic preparations and surgicals while Reckitt and Colman stopped producing cosmetics such as shampoo and talcum power and started producing anti-epileptic tablets.

The decline in diversification levels is far more significant in the case of the other three firms. The Berry's index declined from 0.46 at the beginning of the time-period to 0.17 in the case of Boehringer-Knoll, from 0.40 to 0.22 in the case of Warner-Hindusthan and from 0.22 to 0.12 in the case of Merck Sharpe and Dohme. Profitability P_1 also declined as

witnessed by the fact that it has a positive relationship with DIV. The Berry's index of diversification has, however, increased in the cases of Ranbaxy and Hoechst. At the beginning of the time-series it stood at 0.01 and 0.12 in these two cases respectively. At the end of the time-series, it stood at 0.55 and 0.35 and as witnessed by the positive relationship with DIV, P_1 also increased. In the case of Boots, however, P_1 declined although the level of diversification increased, as indicated by the negative relationship. From the above analysis it seems that more than diversification it is the success that the diversification meets with that determines its impact on profitability.

When model 4.2 is applied, wherein to recollect P_2 is the dependent variable, the relationship between P_2 and DIV is negative in twenty-two cases and positive in fourteen. This can be seen from Table 4.3(b). However, DIV is significant, at different levels, in thirteen regressions only, in seven of which it carries a negative sign. In the six other regressions the sign on DIV is positive. The general explanatory power of this model is not satisfactory. The F-test is significant in four cases alone. Some cases do show moderately high $\bar{R}^2$'s such as Boehringer-Knoll and Cynamid. But other than these few cases the model has not performed satisfactorily. These results, therefore, tend to follow a pattern similar to the results obtained by applying

model 4.1 and shown in Table 4.3(a) with diversification being found an important variable in a few cases alone. A closer look at the firms in whose cases DIV is significant shows that diversification does not have the same effect on profitability in every case. Consider the cases of Ranbaxy or Hoechst. The degree of diversification has steadily increased in these two cases, as already mentioned. And as indicated by the positive relationship their profitability has correspondingly increased. On the other hand, Boots and Cynamid which also diversified steadily[1] have experienced declines in the level of profitability as indicated by the negative relationship between profitability and diversification in their cases. Let us now consider the cases where DIV declined. Take Boehringer-Knoll. It experienced a decrease in the degree of diversification over the time-period but as indicated by the positive relationship between profitability and diversification its profitability has correspondingly declined. On the other hand, Duphar Interfran also experienced a decrease in the degree of diversification[2] but as indicated by the negative relationship between profitability and diversification its profitability improved.

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1. Berry's index increased from 0.13 to 0.34 over the time-period in the case of Boots and from 0.43 to 0.50 in the case of Cynamid.

2. The Berry's index stood at 0.49 and 0.29 in the beginning and end of the time-period in the case of Duphar Interfran.

A comparison of the time-series results obtained from the two models shows that in some cases diversification has had an identical effect on profitability as measured by either ratio. In the cases of Boehringer-Knoll, Ranbaxy, Hoechst and Merck Sharpe and Dohme DIV is positive and significant when either model is applied. Likewise DIV is negative and significant in the cases of Boots and Cynamid when either model is applied. However, in the cases of Duphar-Interfran, Alembic, Richardson-Hindusthan, Nila Products, Ciba Geigy, Roche, and Burroughs Wellcome DIV is not significant when model 4.1 is applied but becomes significant when model 4.2 is applied. Quite the opposite is seen in the cases of Glaxo Laboratories, Warner-Hindusthan and Reckitt and Colman. In their cases DIV is significant when model 4.1 is applied and insignificant when model 4.2 is applied. To some extent then, the results in individual cases tend to vary depending on the measure of profitability used. We now turn to an examination of the stability motive.

In a number of cases it is seen that diversification did not have a significant association with profitability. Did then firms diversify to achieve a measure of stability in profit rates? The next section examines this hypothesis.

4.8 DIVERSIFICATION AND PROFIT RATE STABILITY

To examine the stability motive, the variance of P_2 is regressed on DIV which is computed as an average of the time-

in the different lines of production that it has undertaken. If the firm meets success when it undertakes new lines of production its overall profitability improves. If it does not meet with success its profitability will decline. The motive behind, diversification is also important in determining its influence on profitability. Given the prevalence of overnmental regulation in the industry a firm may find its growth opportunities blocked in the existing line of production or its profitability may come under attack. A firm may, therefore, diversify for defensive reasons. In such cases as Needham says "Also, where a firm diversifies for defensive reasons the firm's profit may even decline on balance; they may, however, have declined less than in the absence of diversification" [Needham 1969, p. 130].

Table 4.1(a)

Break-up of Sales Turnover - Firms in Narayana [1984]

(in crores of Rs.)

Year	Bulk drugs	Formulations	Non-pharmaceutical activity	Total
1977-78	25.60 (6.2)	354.86 (85.5)	34.48 (8.3)	414.95 (100.00)
1980-81	41.32 (5.9)	593.80 (84.4)	68.30 (9.7)	703.48 (100.00)

Figures in brackets indicate percentage of total turnover

Source: The Indian Pharmaceutical Industry: Problems and Prospects: NCAER 1984

Table 4.1(b)

Break-up of Sales Turnover - Firms in this study

(in crores of Rs.)

Year	Bulk Drugs	Formulations	Non-pharmaceutical activity	Total
1977	56.63 (8.12)	409.81 (58.78)	230.77 (33.10)	697.21 (100.00)
1981	75.35 (6.78)	648.51 (58.35)	387.46 (34.86)	1111.32 (100.00)

Figures in brackets indicate percentage of total turnover

Table 4.2(a)

Regression Results (Cross-section): Model 4.1

Year	N	Intercept	DIV	$\bar{R}^2$	F	DW	B-P Statistic
1973	10	0.038 (4.371)	0.004 (0.223)	-0.118	0.049	2.402*	2.637
1974	25	0.051 (2.530)	-0.047 (-0.979)	-0.001	0.959	2.664*	0.302
1977	36	0.047 (3.827)	-0.030 (-1.014)	0.001	1.029	1.593*	2.503
1979	36	0.041 (3.237)	-0.013 (-0.432)	-0.023	0.186	2.090*	2.612
1981	35	0.032 (1.429)	-0.035 (-0.641)	-0.017	0.411	2.059*	5.580
1983	20	0.045 (2.856)	-0.010 (-0.292)	-0.050	0.085	1.917*	0.021

t-values are presented within parenthesis.

* - significant at .01 level.

Table 4.2(b)

Regression Results (Cross-section): Model 4.2

Year	N	Intercept	DIV	$\bar{R}^2$	F	DW	B-P Statistic
1973	10	0.090 (8.563)	0.009 (0.395)	-0.117	0.156	1.590*	0.107
1974	25	0.112 (4.281)	-0.057 (-0.932)	-0.005	0.868	2.788*	2.365
1977	36	0.103 (6.866)	-0.036 (-0.973)	-0.001	0.946	2.114*	5.051
1979	36	0.114 (7.227)	-0.042 (-1.096)	0.005	1.201	2.164*	0.153
1981	35	0.112 (6.125)	-0.034 (-0.764)	-0.012	0.584	2.061*	3.194
1983	20	0.144 (4.030)	-0.072 (-0.848)	-0.014	0.719	2.016*	2.188

t-values are presented within parenthesis

* - significant at .01 level

Table 4.3(a)

Regression Results (Time-series) : Model 4.1

Company	N	Intercept	DIV	$\bar{R}^2$	F	DW
Duphar Interfran	12	0.038 (2.586)	-0.019 (-0.519)	-0.070	0.269	1.425*
Glaxo Laboratories	9	0.230 (7.100)	-0.339 (-5.673)*	0.795	32.190*	1.594*
Boehringer Knoll	9	-0.138 (-3.674)	0.428 (4.114)*	0.665	16.929*	2.303*
Amrutanjan	9	0.021 (3.124)	0.023 (0.120)	-0.140	0.014	1.623*
Rallis	10	-0.007 (-0.179)	0.022 (0.400)	-0.102	0.160	1.702*
Searle	10	0.039 (1.226)	0.123 (1.302)	0.071	1.696	2.344*
Unichem	7	0.029 (2.801)	-0.079 (-1.038)	0.013	1.079	1.846*
Warner Hindusthan	8	0.034 (2.919)	0.061 (1.500)***	0.151	2.251	1.564*
Reckitt and Colman	10	0.383 (1.977)	-0.469 (-1.751)***	0.186	3.066	1.183*
Standard Pharmaceuticals	9	-0.052 (-0.416)	0.136 (0.436)	-0.112	0.190	2.181*
Pfizer	8	0.028 (0.631)	0.169 (0.027)	-0.094	0.394	0.961
Alembic	7	0.100 (1.138)	-0.350 (-0.942)	-0.018	0.888	1.255*
Cadilla	8	0.033 (3.082)	-0.117 (-1.123)	0.036	1.262	0.872
Richardson Hindusthan	9	0.053 (1.760)	-0.086 (-0.663)	-0.075	0.439	1.482*

contd ...

Company	N	Intercept	DIV	$\bar{R}^2$	F	DW
Cipla	9	0.024 (2.830)	0.004 (0.175)	-0.137	0.030	2.657*
Nila Products	8	0.118 (0.126)	-0.242 (-0.247)	-0.005	0.963	1.503*
Ranbaxy Laboratories	10	0.029 (5.994)	0.033 (2.458)**	0.359	6.046**	1.462*
Sandoz	9	0.132 (1.136)	-0.160 (-0.895)	-0.025	0.801	1.775*
German Remedies	11	0.039 (5.700)	0.007 (0.088)	-0.110	0.007	1.887*
Bayer	11	0.288 (1.403)	-0.392 (-1.195)	0.045	1.428	1.437*
J.L. Morrison	10	0.030 (0.557)	-0.003 (-0.052)	-0.124	0.002	3.250*
Albert David	9	0.008 (0.136)	0.012 (0.084)	-0.141	0.007	1.599*
Geoffrey Manners	10	0.064 (1.071)	-0.074 (-0.663)	-0.075	0.440	1.198*
Cynamid	8	0.426 (2.919)	-0.765 (-2.390)**	0.402	5.712**	1.751*
Infar	11	0.075 (2.954)	-0.057 (-0.669)	-0.058	0.448	0.926
Hoechst	9	0.013 (0.645)	0.119 (1.438)***	0.117	2.070	1.241*
Parke-Davies	9	0.048 (7.184)	-0.157 (-1.316)	0.083	1.732	1.365*
Ciba Geigy	9	0.031 (0.710)	0.014 (0.594)	-0.087	0.353	1.331*
Roche	11	0.010 (0.332)	0.151 (1.220)	0.046	1.489	1.647*

contd ...

Company	N	Intercept	DIV	$\bar{R}^2$	F	DW
E. Merck	11	0.008 (0.580)	0.090 (1.331)	0.071	1.773	1.372*
Roussel	11	0.072 (2.482)	-0.102 (-0.849)	-0.028	0.722	2.302*
Hindusthan Antibiotics	10	0.005 (0.005)	-0.419 (-0.199)	-0.119	0.039	1.715*
Merck Sharpe Dohme	9	-0.012 (-1.855)	0.176 (4.991)*	0.749	24.918*	2.316*
Burroughs Wellcome	10	0.052 (4.583)	-0.099 (-1.157)	0.036	1.340	0.827
Curewel	8	0.199 (1.152)	-0.322 (-0.750)	-0.066	0.562	2.040*
Boots	10	0.048 (7.570)	-0.038 (-1.460)***	0.111	2.133	1.132*

t- values are presented within parenthesis

* - significant at .01 level

** - significant at .05 level

*** - significant at .10 level

Table 4.3(b)

Regression Results (Time-series): Model 4.2

Company	N	Intercept	DIV	$\bar{R}^2$	F	DW
Duphar Interfran	12	0.145 (4.621)	-0.134 (-1.665)***	0.138	2.773	2.490*
Glaxo Laboratories	9	0.167 (1.784)	-0.136 (-0.787)	-0.049	0.619	1.702*
Boehringer Knoll	9	-0.068 (-1.431)	0.430 (3.249)*	0.544	10.556*	2.003*
Amrutanjan	9	0.081 (4.484)	-0.169 (-0.318)	-0.126	0.101	1.193*
Rallis	10	0.105 (0.860)	-0.018 (-0.120)	-0.122	0.014	3.321*
Searle	10	0.115 (2.344)	0.145 (0.996)	-0.001	0.993	1.732*
Unichem	7	0.108 (3.804)	-0.124 (-0.592)	-0.121	0.351	2.007*
Warner Hindusthan	8	0.123 (7.409)	-0.007 (-0.134)	-0.163	0.018	1.244*
Reckitt and Colman	9	0.293 (0.060)	-0.146 (-0.021)	-0.142	0.001	2.071*
Standard Pharmaceuticals	9	0.082 (0.448)	-0.146 (-0.323)	-0.126	0.104	2.250*
Pfizer	8	-0.022 (-0.192)	0.681 (0.983)	-0.004	0.966	0.882
Boots	10	0.126 (13.408)	-0.073 (-1.902)**	0.225	3.621	2.117*
Alembic	7	0.254 (2.982)	-0.711 (-1.982)**	0.328	3.931	2.398*
Cadilla	8	0.147 (1.612)	0.435 (0.502)	-0.119	0.252	0.606

contd ...

Company	N	Intercept	DIV	$\bar{R}^2$	F	DW
Richardson Hindusthan	9	0.217 (3.234)	-0.466 (-1.626)***	0.170	2.643	1.514*
Cipla	9	0.059 (3.043)	0.077 (1.270)	0.071	1.613	2.105*
Nila Products	8	0.266 (1.952)	-0.410 (-1.541)***	0.164	2.376	1.581*
Ranbaxy Laboratories	10	0.106 (11.026)	0.038 (1.464)***	0.112	2.143	2.153*
Sandoz	9	0.457 (1.092)	-0.549 (-0.852)	-0.035	0.727	2.094*
German Remedies	11	0.117 (5.323)	0.032 (0.117)	-0.109	0.013	0.657
Bayer	11	0.112 (0.360)	0.017 (0.034)	-0.110	0.001	1.323*
J.L.Morrison	10	0.115 (0.991)	-0.033 (-0.211)	-0.118	0.044	1.898*
Albert David	9	0.043 (0.359)	0.056 (0.197)	-0.136	0.038	0.892
Geoffrey Manners	10	0.149 (1.169)	-0.115 (-0.482)	-0.093	0.232	1.590*
Cynamid	8	0.547 (3.066)	-0.957 (-2.451)**	0.417	5.009**	1.703*
Infar	11	0.131 (4.686)	-0.101 (-1.074)	0.015	1.153	0.786
Hoechst	9	0.045 (1.241)	0.296 (2.086)**	0.295	4.354	1.133*
Parke-Davies	9	0.108 (7.025)	-0.184 (-0.665)	-0.074	0.442	2.854*
Ciba-Geigy	9	0.001 (0.009)	0.204 (1.406)***	0.108	1.978	1.760*

contd ...

Company	N	Intercept	DIV	$\bar{R}^2$	F	DW
Roche	11	-0.002 (-0.067)	0.349 (2.316)**	0.303	5.364**	2.390*
E. Merck	11	0.094 (5.195)	0.027 (0.307)	-0.099	0.094	1.299*
Roussel	11	0.189 (4.076)	-0.208 (-1.080)	0.016	1.166	2.624*
Hindusthan Antibiotics	10	0.581 (1.073)	-1.270 (-1.191)	0.044	1.419	1.721*
Merck Sharpe Dohme	9	0.065 (3.187)	0.148 (1.398)***	0.106	1.956	1.078*
Burroughs Wellcome	10	0.096 (9.387)	-0.194 (-2.540)**	0.377	6.454**	1.444*
Curewel	8	0.181 (1.908)	-0.244 (-1.033)	0.009	1.069	2.370*

t-values are presented within parenthesis

* - significant at .01 level

** - significant at .05 level

*** - significant at .10 level

Table 4.4

Stability of Profit Rate and Diversification

N	Intercept	DIV	$\bar{R}^2$	F	DW
36	0.002 (2.206)	-0.002 (-0.969)	-0.001	0.940	2.206*

t-values are presented within parenthesis

* - significant at .01 level

CHAPTER 5

PROFITABILITY AND VERTICAL INTEGRATION

5.1 INTRODUCTION

Vertical Integration is an aspect of the structure of a firm closely related to diversification. The degree of vertical integration is defined as the extent to which a firm performs successive stages in the production of a particular product [Needham 1969]. If one were to define the output of the different stages of production as different products, vertical integration can then be treated as an aspect of diversification. However, the considerations which motivate vertical integration differ in a number of ways from the considerations which motivate diversification. The literature contains a number of studies which have focussed on the determinants of vertical integration. The major determinants identified by these studies are costs of using the market, market power considerations and government policies. Silver (1984) has a good review of these considerations.

Use of the market to organize production involves a certain cost, otherwise known as transaction costs. Some examples of transaction costs are search costs, costs of drawing up contracts, monitoring costs and the like. A firm

can avoid incurring these costs by organizing production internally and thus replacing the market. Some examples would demonstrate the benefits of internal organization o of production. The first example that can be conjured up is forward integration into distribution. This would save the firm selling commission normally paid to independent distributors. A second example is that of an upstream firm which may have to engage in advertising and other sales promotion activities, to attract firms further downstream. By integrating into downstream activities the firm saves these advertisement costs. A further example of the benefits of vertical integration is in the area of inventory. A vertically integrated firm need only maintain smaller levels of stock of the output of an earlier stage compared to a firm which is not integrated. This would not only save the firm interest charges but also intermediate profits which form a part of the price paid for the output of an independent supplier. Another example of a situation where vertical integration may be advantageous is when the costs of performing successive productive stages decrease when combined under single managerial supervision. The use of the market also involves a certain risk. For instance the use of the market to organize production may result in opportunistic behaviour by suppliers [Klein, Crawford and Alchian 1978]. Opportunism by suppliers results from the first-mover

advantages gained by the supplier during pre-production development for the producer [Monteverde and Teece 1982]. The supplier can at the last moment ask for and receive a higher than contracted price as it may be far more costlier for a producer to switch to an alternate inexperienced producer. Vertical integration may also be the answer to quality control problems when the measurement cost of the quality of intermediate products is high. This point has been brought out by Auster and Silver [1973] and stressed by Mark Casson [1982, pp. 15-16]. To quote Auster and Silver, "In certain cases [contract] enforcement via measurement of the quality and quantity of non-human factors supplied by other firms is quite costly relative to the cost of indirectly controlling the quality of these items by controlling the inputs used to produce them. Our conclusion is that, ceteris paribus, the higher the cost of directly controlling the quantity and quality of non-human inputs relative to achieving control via their own inputs, the greater the degree of vertical integration" [Auster and Silver 1973, p. 12]. Another situation where vertical integration presents a less costly option is when conditions of information impactedness prevail. To quote, "the entrepreneur will find that his least costly option for dealing with market bottlenecks is to purchase or rent the capital equipment and labor services of the local producers and

employ them to produce the desired operation within his own firm" [Silver 1984, p. 15]. It is because the use of the market entails such costs that Coase [1937] asserts that the firm will expand until the costs of organizing operations within the firm become equal to the costs of carrying out the same production operations by means of an exchange in the open market.

Apart from the desire to minimize the costs of using the market, it was mentioned that market power considerations also fuel vertical integration. Vertical integration presents the firm the opportunity to indulge in monopoly practice such as market foreclosure, price discrimination, the squeeze play and so on. A common example to demonstrate market foreclosure is the purchase of retail outlets by a producer thus preventing competitors from having access to the markets served by these outlets. The problem can be serious if the retail outlets have a measure of monopoly power. But it has been pointed out that the integrating firm may not be able to capture any of the monopoly profits. The argument is that the monopolistic chain would have been sold to the integrating firm only at a price that capitalized the future stream of monopoly profits [Clarkson and Miller 1982, pp. 344-345]. This point is further brought home by the argument that under constant demand and cost conditions and given fixed factor proportions any merger between a monopolistic and competitive

firm at successive stages of production and distribution will not change the price and output levels, as the existing monopolist would already have taken account of the effect of the output level on the price of the final product [Needham 1969, p. 118]. We are reminded again that monopoly in any part in the chain of production and distribution will not confer monopoly power at any other point in the chain. Only competitive profits can be earned on the additional investment in the case of vertical integration [Allen 1971].

However, price discrimination presents the firm real possibilities of increasing its profitability [Perry 1978]. An example is that of an intermediate goods manufacturer who by integrating forward into markets for which his product serves as a common input may, depending on the price elasticities of demand, indulge in price discrimination. Consider the case of a producer of aluminium ingots. He cannot discriminate in the price of aluminium ingots. However, by integrating forward into the production of items like pots, pans, car grills etc., he can take advantage of whatever differing price elasticities there are in the demand for these products to increase his profitability [Clarkson and Miller 1982, p. 346]. The squeeze play is not an unrealistic possibility either, though not without costs to the firm. It happens when an integrated firm having a monopoly over some input charges a high price for it from the non-integrated competitor in the final product market

and simultaneously uses its position to lower the price of the final output. This makes it unprofitable for the non-integrated firm to produce that product and it is therefore forced out of business. However, during this period the integrated firm will have to forgo some profits consequent to the reduction in the price of the final product [Clarkson and Miller 1982, p. 345].

The arguments that vertical integration may lead to the creation of market power revolve on the entry barriers which arise as a result of the increase in the absolute amount of capital investment required of competitors trying to make an entry. This is necessitated by the new entrants having to enter at more than one level to be competitive with the integrated firm.

The other important determinant of vertical integration was mentioned as government policies, such as regulation. Price-Control is a form of regulation. Vertical integration presents a way of reducing the impact of price-controls on performance. At the control price the quantity demanded of an input may exceed quantity supplied and a firm may not get enough of its requirements. To eliminate this problem of availability the firm might itself integrate backward into input production. By integrating it may also be possible for the firm to adjust internal transfer prices of intermediate goods in situations of rigid price control. Levin has noted for the oil industry

that while the setting of internal transfer prices for crude oil above its market value may be prohibited, detection would not be easy [Levin 1981, p. 219]. Stigler, in fact, reasons that the desire to circumvent problems of non-price rationing may have provided the rationale for a number of vertical mergers in the United States after World War II [Stigler 1951, pp. 190-191].

Vertical integration, thus, is an important determinant of profitability, acting either through cost effects or through market power or because a vertically integrated firm is better placed to resist the effects of government regulation. It therefore assumes considerable significance as a firm-level structural determinant of profitability.

5.2 VERTICAL INTEGRATION IN THE INDIAN PHARMACEUTICAL INDUSTRY

Any increase in the extent of vertical integration in the Indian pharmaceutical industry can in the main be directly attributed to two reasons. Firstly as Adelman noted, in rapidly growing or changing industries, a sluggish response would often force the growing firm to provide its own supply of inputs and marketing outlets [Adelman 1955, p. 319]. The pharmaceutical industry in India has grown tremendously and it is quite possible that firms had integrated backward in response to a slow increase in the supply of inputs from external sources and forward into distribution in an effort to cover the market quickly in the face of rising demand for pharmaceutical products.

The second reason is Government pressure. While it cannot be ruled out that other factors did not have a role to play these two reasons would definitely rank as the major deter minants.

In the pre-independence days the earliest pharmaceutical firms were performing only downstream activities such as repacking and marketing of medical products imported from abroad. But both the situation during World War II and the encouragement of the Government after independence saw some firms establish small manufacturing and tabletting operations. The pharmaceuticals produced were simple preparations. However, the bulk of the production was still dependent on imported chemicals and drugs. In 1952 only a few drugs such as tetanus anti-toxin, PAS, Iodochlorhydroxyquinoline were being produced in India from the basic stages. Thus in the case of the early firms it was mostly a matter of backward integration.

In order to speed up the process of integration Government pressure was brought to bear upon the firms in the industry. The Pharmaceutical Inquiry Committee [1954] whose recommendations formed the basis of much of Government policy towards the industry, identified this 'weakness' in the industry's structure and recommended that each manufacturing concern be made to produce as many fine chemicals and drugs from the basic stages. This recommendation was also motivated by foreign exchange considerations owing to the import of bulk drugs from

abroad. The reasons for the early pharmaceutical firms not undertaking integration are not too far to seek. The average profit in producing formulations was nearly double the profit on investment in producing bulk drugs so much so that all pharmaceutical firms concentrated only on the downstream formulation activity [Ramachandran and Rangarao 1972, p. M-29]. Meanwhile, the state itself decided to enter bulk drug production and in 1954 established the Hindusthan Antibiotics Limited. Simultaneously the Directorate General of Technical Development in issuing licenses to new manufacturers saw to it that development of the industry was as integrated as possible. By 1967, Ramachandran and Rangarao estimate, 77 out of a total of 2,349 firms in the industry produced basic pharmaceuticals and by 1972 over 100 essential drugs were being produced [Narayana 1984, p. 42].

Another possible reason for firms to opt for a greater degree of integrated production was the imposition of price controls in the late sixties and seventies. With sale prices fixed and the cost of inputs increasing the firms in the industry had no option but to perform some of those operations previously organized by the market in order to reduce costs and maintain their profitability. The New Drug Policy announced in 1978 further tightened the screws compelling many firms to take up the production of bulk drugs and fine chemicals. The new regulations were tougher or foreign manufacturers vis-a-vis

Indian manufacturers. Some measures announced in the New Drug Policy were :

(a) Indian drug manufacturers were to be allowed licenses for formulation activity upto a maximum of ten times the value of their bulk drug production, provided the formulation turnover was based on a ratio of 2:1 between the consumption of indigeneous and imported bulk drugs. For foreign manufacturers this ratio was fixed at 5:1.

(b) Foreign firms were required to take up the production of bulk drugs and intermediate products from the earliest stage within two years.

(c) Foreign firms which did not produce bulk drugs, but only processed imported or locally purchased bulk drugs into formulations were required to bring down their foreign equity holding to 40% of the total.

(d) The Drug (Prices Control) Order 1979 fixed a higher profit rate ceiling on formulation activity for those firms which also produced bulk drugs. Other factors taken into consideration included size of firm and its R and D investment. Thus for a small unit [less than Rs. 1 crore turnover] the profit ceiling was fixed at 12% on sales turnover while the ceiling for similar sized units having bulk drug production activity at 5% or more of total sales turnover was 13% of sales turnover and so on.

Last of all, mention must be made of the high rate of duties, including heavy customs duties on imports which pushed up the costs of production when final sale prices were fixed. This also ensured that firms had to commence the manufacture of imported inputs if they were to continue to operate in the final output market.

All of the above mentioned factors did contribute to increasing the level of backward integration. This is seen in the steady increase in the number of bulk drugs and drug intermediates produced locally. One estimate [Kothari's index] puts the number of bulk drugs currently produced in India to be above 400. The growth rate in the production of bulk drugs has also been greater than the growth rate in the production of formulations. The annual growth rate (compounded) of the production of bulk drugs was 17.7% between 1965-66 and 1981-82 whereas the annual growth rate of the production of formulations was 14.2% over the same period. In 1965-66 the value of bulk drug production was Rs.18 crores and of formulations Rs. 150 crores respectively. By 1981-82 they had risen to Rs. 289 crores and Rs.1430 crores respectively. This can be seen in Table 5.1.

The above discussion of vertical integration in the industry has emphasized mostly on backward integration. However, there are a few instances especially in the public sector of forward integration into the production of formulations

For example, IDPL a public sector firm set up mainly to manufacture bulk drugs and drug intermediates, started producing formulations. Besides, most of the pharmaceutical firms were well integrated into downstream activities. Apart from producing formulations, they did most of the packaging and much of the distribution at the wholesale level. They are, however, absent at the retail level.

Given the increasingly integrated production by firms it would be interesting to see what role it may have had in determining profitability.

5.3 EMPIRICAL EVIDENCE

A majority of the empirical studies on vertical integration have tended to be on its determinants. However, two recent papers, Ravenscraft [1983] and Martin [1986] have studied the effect of vertical integration on profitability. Ravenscraft's study included vertical integration as a variable in a larger model explaining line of business profitability. While vertical integration at the line of business level was taken care of by including a dummy variable, industry-level vertical integration was measured by the weighted sum of line of business vertical integration. His results showed a positive relationship between line of business profitability and line of business vertical integration whereas the relationship between line of business profitability

and industry-level vertical integration was strongly negative. His inference, to quote, was "there appear to be advantages to an LB [line of business][1] from being vertically integrated ... but those advantages are lessened, possibly through the rent-eroding impact of competition, if other LB's in the industry are also integrated ... " [Ravenscraft 1983, p. 26].

Martin's study, on the other hand, was done at the industry level. In his model he included variables to measure both forward and backward integration. His study showed that the interactive effects of integration on profitability were complex and differed from sample to sample. In some cases, vertical integration acted as a support to the positive effect of concentration on profitability. In other cases, however, he found that extensive integration neutralized the effect of concentration on profitability. He feels that the effect of vertical integration on industry profit rate depends on whether the integration is into or out of the industry.

As far as the pharmaceutical industry is concerned there had been no specific study. In the Indian context this aspect has been largely ignored even for industries in general not to speak of this industry or the micro firm-level. An examination of the contribution this variable makes in determining the profitability of pharmaceutical firms thus assumes great importance.

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1. Brackets mine.

5.4 THE EMPIRICAL ANALYSIS : SPECIFICATION OF THE MODELS

In order to examine the relationship between profitability and vertical integration two models are specified. They are described below.

$$P_1 = a + b_1 VI + u \qquad (5.1)$$

$$P_2 = a + b_1 VI + u \qquad (5.2)$$

where P_1 and P_2 are the two measures of the profitability of the firm as already defined earlier.

VI is the measure of vertical integration defined as the ratio of value-added to total sales turnover and u is the random disturbance term.

Value-Added is defined as the total sales turnover less costs of raw materials, fuel, power, repair charges and customs, excise duties.

The rationale behind the use of the value-added measure to capture the extent of vertical integration is that the greater the number of successive productive stages that are performed by the firm the greater will be the magnitude of this ratio. However, the use of this ratio has certain disadvantages. Firstly, the ratio is biased towards backward integration. Secondly, it is susceptible to differences in the rate of change over time of input and output prices. Lastly, since profits are included in the measure of value-added, a firm earning higher profits will be shown to be more integrated

than a firm earning smaller profits even though physically they perform identical production operations [Adelman 1955; Needham 1969, pp. 124-125]. While being aware of these drawbacks the nature of the available data left no other alternative. At the industry level recent measures of vertical integration like those in Martin [1986] rely on the 'use' and 'make' input-output tables. At the firm-level, however, the absence of similar kind of data precludes the use of better indicators of the degree of vertical integration. This is probably why Ravenscraft [1983] used a dummy variable to capture line of business vertical integration.

The sample for this part of the study consists of thirty-seven firms from the original sample of thirty-eight firms. One firm had to be dropped due to the non-availability of the break-up of cost data essential for calculating value-added. The study covers the entire period 1970-83.

5.5 REGRESSION RESULTS: CROSS-SECTION

The results of the analysis using cross-section data are presented in Tables 5.2(a) and 5.2(b). Table 5.2(a) presents the results obtained by applying model 5.1 to the data, wherein P_1 is regressed on VI.

It can be seen from the table that the Breush-Pagan test does not reveal the presence of heteroscedasticity. VI is positive throughout and significant either at the 0.01 or 0.05 level in

five out of the seven regressions. The regressions also seem to have done alright in terms of the goodness-of-fit statistics. The computed F-statistic is significant in three regressions, twice at the 0.01 level and once at the 0.05 level. The $\bar{R}^2$'s, however, are only moderate in value with the highest $\bar{R}^2$ obtained being 0.392. However, it is essential to say that two caveats are in order here. Firstly, a slight upward bias in the results may be possible on account of the rate of return on sales turnover (P_1) being present on both sides of the regression equation. Net profits which is in the numerator of the dependent variable is a part of value-added which is in the numerator of the explanatory variable while the denominators on both sides are common. Secondly, this measure reflects overall integration by the firm and this includes their other lines of manufacture as well. To the extent that these activities form a minor part of a firms overall activity this ratio can be taken to indicate the extent of integration in its pharmaceutical activity.

Table 5.2(b) contains the results of the regression by applying model 5.2 which has P_2 as the dependent variable. The Breush-Pagan test reveals the presence of heteroscedasticity in one regression. To compensate, weighted least squares are estimated, the weight used being the square root of VI. The argument is, that the greater the extent of vertical

integration the smaller the degree to which the firm is exposed to market risks consequent to the firm using the market to organize production and therefore smaller is the variation in profitability. The results show that VI is generally positive. However, it is significant in only two regressions, once each at the 0.01 and 0.05 levels. The F-statistic is significant in only one regression. The $\bar{R}^2$'s are generally low but a moderate value of 0.388 is obtained in the year 1970. The implication is that although VI may be an important determinant its association with profitability may not be as strong as model 5.1 earlier suggested. In the years 1970 and 1977, VI is significant when either model is used. However, in the years 1972, 1979 and 1983 VI is significant only when model 5.1 is used. The explanation may lie in the different profitability measures used by the two specifications. Even though the numerator in P_2, operating profit, constitutes a part of value-added which is in the numerator of the explanatory variable, the denominators are different with total assets being in the denominator of the dependent variable and total sales turnover being in the denominator of the explanatory variable. Therefore, the dependent variable, as a whole, does not become a part of the independent variable and this reduces the extent of bias.

5.6 REGRESSION RESULTS : TIME-SERIES

Tables 5.3(a) and 5.3(b) present the results of the time-series analysis. The results obtained by applying model 5.1 to the data are presented in Table 5.3(a). The Durbin-Watson test for autocorrelation shows it is generally absent. The results show that VI is positive in thirty regressions and negative in only seven. VI is significant in twenty-two regressions at different levels, in twenty of which VI is positive in sign. The F-statistic is significant in seventeen regressions at either the 0.01 or 0.05 levels. The R^2's are reasonably high in quite a few cases and take more moderate vaoues in a few others indicating that the regressions were relatively successful in a number of cases. An examination of the time-series data in many cases where VI is positive and significant, shows that the ratio of value-added to total sales turnover has declined steadily over the time-period. For instance, the ratio decreased from 0.55 in 1970 to 0.39 in 1983 in the case of Duphar Interfran, from 0.49 to 0.37 in the case of Boehringer-Knoll, from 0.63 to 0.47 in the case of Warner-Hindusthan and so on. P_1 has correspondingly decreased as indicated by the positive significant VI. The exceptions to this are Cadilla, J.L. Morrison and IDPL in all of whose cases the ratio of value-added to sales has increased over time, for instance from 0.06 to 0.30 in Cadilla's case, from 0.24 to 0.38 in the case of J.L. Morrison and from 0.08

to 0.45 in the case of IDPL. Correspondingly, P_1 has also increased in their cases. A slight contrast is also observed in the two instances where VI is significantly negative. In the case of Ranbaxy, P_1 increased as the ratio of value-added to sales decreased. However, in the case of Infar P_1 decreased as the ratio of value-added to sales increased.

Any decrease in the ratio of value-added to sales while indicating that the extent of integration has been declining over time, does not necessarily imply that the firms have disintegrated. The pharmaceutical firms may have maintained or even increased the extent of 'physical' integration in certain lines of production but the addition of a number of new products over time, the manufacturing operations of all of which may not have been integrated, might have contributed to the decrease in the ratio of value-added to sales. Thut it is seen that while value-added increased over time the denominator in the ratio [sales turnover] increased at a much faster rate and this led to an overall decline in the ratio. One explanation may be that seeing the potential for new products the firms may have decided to introduce them in the short run using inputs purchased from local sources or imported from abroad, to get an advantage in the market. Another explanation for the slow rate of integration may lie in the possibly unremunerative or low return on investment in bulk drug production granted by the Government. Considerations of economies

of scale may also be involved with the size of the market not being large enough to invest in separate plants for the economical manufacture of drug inputs. In such circumstances it may be cheaper to import the raw materials from abroad, especially from their principals. The firms may have been just content in meeting the minimum statutory requirements of the Government such as the 5:1 and the 10:1 ratios between the value of formulations and bulk drug production rather than investing in integrated production for reasons such as those mentioned above. Such a reluctance can be seen from the fact that many foreign companies preferred to reduce their foreign equity holdings to 40% or less of the total, to be classified as Indian companies rather than commence production of key inputs from the basic stages which is a Government pre-condition to continue to be classified as a foreign company. This is probably why the import bill of bulk drugs increased from Rs.57.58 crores in 1977-78 to Rs.75.86 crores in 1981-82 most of which went to meet the needs of a growing market. One last reason probably relates to the composition of the ratio itself. Since P_1 forms a part of the ratio of value-added to sales, as already mentioned, a decrease in P_1 can lead to a decrease in the ratio of value-added to sales turnover. In sum, all these factors may have been responsible for the decrease in the ratio.

The results of the time-series analysis obtained by applying model 5.2 to the data are presented in Table 5.3(b). From the table it can be seen that VI is positively related to P_2 in twenty regressions and negatively related in seventeen. VI is, however, significant in fourteen regressions only, being positively significant in nine regressions and negatively significant in five regressions. The goodness-of-fit statistics show that the model is successful in explaining a significant amount of the variation in P_2 in some cases only. The F-statistic is significant in six regressions and the value of the $\bar{R}^2$'s obtained range from moderate to low in most cases.

Comparison of the two sets of results presented in Tables 5.3(a) and 5.3(b) leads to the suspicion that regressions using model 5.1 may have overestimated the influence of vertical integration in determining profitability. The use of model 5.2 results in an increase in the number of regressions in which VI is negative. Further the number of regressions in which VI is significant are fewer when compared to model 5.1. The change in sign has been drastic in some cases. For instance when model 5.1 is used, VI is positive and significant in the case of Boots. But when model 5.2 is used VI turns negative and significant. In other cases such as Duphar Interfran, Boehringer-Knoll and Amrutanjan, VI is significant when model 5.1 is used but insignificant when model 5.2 is used.

This leads to the suspicion of over-estimation by model 5.1. It seems possible in some of these cases that though P_1, which is the profitability on sales, decreased because cost increases arising from a reduction in the extent of integrated manufacturing operations ate into the profit margins, P_2 the return on assets remained relatively unaffected. The firms probably compensated the fall in the profit margins with increased sales so that the amount of absolute profits may have remained the same leading to a constant P_2. It is also seen in some cases that P_2 may have increased because of an increase in sales, although P_1 remained unaffected. This seems plausible if we view the cases of Glaxo Laboratories, German Remedies, and Burroughs Wellcome. In each of these cases VI is insignificant when P_1 is the dependent variable. But when P_2 is the dependent variable VI is negative and significant in every case. Considering that the extent of integration had declined in each case P_2 had increased over the time-period while P_1 remained unaffected. There are also cases where VI remains positive and significant regardless of which specification is used. Barring the cases of Cadilla, Nila Products and J.L. Morrison the extent of integration declined in each case. While P_1 seems to have experienced a corresponding decrease as witnessed by the positive VI, P_2 has also decreased probably indicating that these firms have not been so successful in compensating the fall in profit margins by increasing sales so that P_2 remained

unaffected. In the cases of the three exceptions mentioned, however, both P_1 and P_2 are seen to have increased along with the extent of integration.

5.7 CONCLUDING REMARKS

The study shows that vertical integration is an important determinant of firm-level profitability in the pharmaceutical industry. Cross-section results obtained using model 5.1 in which P_1 is the measure of profitability, reveals the strong positive influence of vertical integration on profitability. The study repeated using model 5.2, in which P_2 is the profitability measure, while tending to confirm the importance of vertical integration as a structural variable in determining profitability, however, shows that the results obtained using model 5.1 may have been overestimated. The time-series analysis with model 5.1 also reveals a predominantly positive relationship between profitability and vertical integration. A close examination of the data shows that the ratio of value added to sales turnover which is used to measure vertical integration declined during the period of this study implying that that the extent of 'physical' integration has not increased as significantly as was expected. The time-series analysis using model 5.2 again leads to the conclusion that model 5.1 may have overestimated the importance of vertical integration as a profitability determinant. The analysis with model 5.2 also shows

that a negative relationship between P_2 and vertical integration prevails in a few cases. In the short run, it seems, the strategy of increasing production by going in for market purchase or import of inputs has paid off in these cases. But in the long run, as competition increases, this strategy may not be so fruitful. Internalizing production may then be essential in maintaining profitability.

Table 5.1

Production trends - Bulk Drugs and Formulations

Year	Bulk Drugs	Formulations (Rs crores)
1965-66	18	150
1971-72	50	300
1975-76	130	560
1976-77	150	700
1977-78	164	900
1978-79	200	1050
1979-80	226	1150
1980-81	240	1200
1981-82	289	1430
1982-83*	325	1545

* Anticipated.

Source - Ministry of Chemicals and Fertilizers : Annual Report, 1982-83.

Table 5.2(a)

Regression Results (Cross-section): Model 5.1

Year	N	Intercept	VI	$\bar{R}^2$	F	DW	B-P Statistic
1970	32	-0.056 (-2.267)	0.217 (4.510)*	0.392	20.345*	1.980*	1.884
1972	36	-0.031 (-0.968)	0.141 (2.308)**	0.110	5.327**	1.771*	0.074
1974	34	-0.019 (-0.428)	0.108 (1.139)	0.008	1.298	2.090*	5.793
1977	36	-0.037 (-1.353)	0.170 (2.773)*	0.160	7.694*	1.963*	3.373
1979	37	-0.002 (-0.121)	0.088 (1.738)**	0.053	3.022	2.063*	5.095
1981	37	-0.021 (-0.459)	0.091 (0.874)	-0.006	0.764	1.787*	1.359
1983	33	-0.052 (-1.331)	0.187 (2.021)**	0.086	4.048	1.873*	1.912

t-values are presented within parenthesis ; * - significant at 0.01 level

** - significant at 0.05 level

Table 5.3(a)

Regression Results (Time-series): Model 5.1

Company	N	Intercept	VI	$\bar{R}^2$	F	DW
Duphar Interfran	14	-0.018 (-0.765)	0.119 (2.217)**	0.231	4.916**	0.893
Glaxo Laboratories	14	0.058 (1.408)	-0.023 (-0.274)	-0.076	0.075	0.936
Boehringer Knoll	14	-0.118 (-2.213)	0.324 (2.597)**	0.306	6.745**	1.981*
Amrutanjan	14	-0.033 (-1.532)	0.153 (2.661)*	0.318	7.085**	1.791*
Rallis	13	-0.002 (-0.249)	0.063 (1.182)	0.032	1.398	1.871*
Searle	14	-0.163 (-1.690)	0.440 (2.711)*	0.328	7.354**	1.077*
Unichem Laboratories	14	0.003 (0.344)	0.033 (1.280)	0.050	1.639	2.305*
Warner Hindusthan	14	-0.018 (-1.330)	0.150 (5.404)*	0.684	29.212*	1.566*
Reckitt and Colman	14	0.035 (1.322)	0.022 (0.412)	-0.068	0.170	1.019
Pfizer	14	-0.082 (-2.497)	0.289 (4.441)*	0.590	19.724*	1.128*
Boots	14	-0.020 (-0.580)	0.129 (1.815)**	0.150	3.297	0.850
Chemopharma	13	-0.069 (-1.778)	0.236 (1.900)**	0.178	3.612	1.642*
Alembic	14	-0.026 (-0.579)	0.123 (1.106)	0.016	1.223	1.761*
Cadilla	8	-0.014 (-1.078)	0.122 (3.071)*	0.546	9.435**	1.573*

contd ...

Company	N	Intercept	VI	$\bar{R}^2$	F	DW
Richardson Hindusthan	13	-0.049 (-1.245)	0.149 (2.245)**	0.237	5.041**	0.840
Cipla	14	0.066 (1.232)	-0.108 (-0.882)	-0.017	0.778	2.286*
Nila Products	12	-0.167 (-2.013)	0.443 (1.994)**	0.213	3.978	1.571*
Ranbaxy Laboratories	14	0.094 (3.546)	-0.124 (-2.127)**	0.213	4.526	1.089*
Sandoz Laboratories	14	0.002 (0.316)	0.068 (3.136)*	0.404	9.839*	1.177*
German Remedies	14	0.005 (0.189)	0.085 (1.204)	0.033	1.451	1.700*
Bayer	14	-0.127 (-3.292)	0.485 (5.148)*	0.662	26.511*	1.367*
J.L. Morrison	14	-0.040 (-1.175)	0.156 (1.680)***	0.123	2.825	1.109*
Albert David	14	0.034 (0.795)	-0.053 (-0.463)	-0.064	0.214	1.688*
Geoffrey Manners	13	-0.014 (-2.315)	0.139 (7.700)*	0.829	59.301*	1.462*
Cynamid	12	-0.471 (-4.339)	0.481 (6.096)*	0.783	37.157*	2.441*
Infar	13	0.247 (3.091)	-0.276 (-2.299)**	0.263	5.287**	1.478*
Hoechst	14	-0.169 (-2.151)	0.552 (3.020)*	0.384	9.122*	1.173*
Parke Davies	14	-0.049 (-1.343)	0.211 (2.912)*	0.365	8.480**	2.474*
Ciba Geigy	13	0.082 (2.997)	-0.060 (-1.033)	0.005	1.068	1.139*

contd ...

Company	N	Intercept	VI	$\bar{R}^2$	F	DW
Roche	14	0.026 (0.560)	0.067 (0.638)	-0.047	0.408	1.115*
E. Merck	14	0.024 (0.740)	0.001 (0.021)	-0.083	0.0004	1.063*
Roussel	14	-0.031 (-0.308)	0.156 (0.790)	-0.029	0.624	2.264*
Hindusthan Antibiotics	14	-0.654 (-3.002)	0.217 (2.461)**	0.296	6.058**	1.336*
IDPL	14	-0.867 (-7.281)	2.318 (6.372)*	0.752	40.613*	1.126*
Merck Sharpe Dohme	13	-0.027 (-0.794)	0.081 (1.222)	0.043	1.495	2.568*
Burroughs Wellcome	14	0.029 (1.391)	0.027 (0.654)	-0.046	0.428	0.963
Curewel	10	0.173 (2.003)	-0.153 (-1.255)	0.060	1.575	1.593*

t- values are presented within parenthesis

* - significant at .01 level

** - significant at .05 level

*** - significant at .10 level

Table 5.3(b)

Regression Results (Time-series) Model 5.2

Company	N	Intercept	VI	$\bar{R}^2$	F	DW
Duphar Interfran	14	0.091 (1.841)	0.010 (0.090)	-0.082	0.008	1.743*
Glaxo Laboratories	14	0.209 (3.846)	-0.254 (-2.247)**	0.237	5.051**	1.233*
Boehringer Knoll	14	0.037 (0.536)	0.111 (0.672)	-0.044	0.451	2.300*
Amrutanjan	14	0.013 (0.232)	0.164 (1.096)	0.015	1.202	1.162*
Rallis	13	0.102 (2.888)	-0.077 (-0.446)	-0.071	0.199	2.583*
Searle	14	0.047 (0.444)	0.201 (1.123)	0.019	1.261	1.453*
Unichem Laboratories	14	0.062 (2.450)	0.070 (1.197)	0.034	1.434	1.492*
Warner Hindusthan	14	0.145 (7.174)	-0.049 (-1.196)	0.032	1.432	1.320*
Reckitt and Colman	14	0.679 (1.305)	-1.072 (-1.024)	0.003	1.048	2.110*
Pfizer	14	-0.030 (-0.466)	0.249 (1.951)**	0.177	3.807	0.966
Boots	14	0.208 (4.230)	-0.209 (-2.055)**	0.198	4.226	1.670*
Chemo-pharma	13	0.025 (0.666)	0.139 (1.128)	0.022	1.274	1.347*
Alembic	14	0.195 (2.136)	-0.251 (-1.163)	0.026	1.354	1.460*
Cadilla	8	-0.033 (-0.249)	0.687 (1.705)***	0.214	2.907	0.868

contd ...

Company	N	Intercept	VI	$\bar{R}^2$	F	DW
Richardson Hindusthan	13	0.100 (1.617)	0.002 (0.022)	-0.090	0.001	1.045*
Cipla	14	0.128 (1.389)	-0.134 (-0.634)	-0.048	0.403	2.133*
Nila Products	12	-0.135 (-1.128)	0.607 (1.621)***	0.119	2.630	0.963
Ranbaxy Laboratories	14	0.299 (8.201)	-0.430 (-5.346)*	0.679	28.583*	2.100*
Sandoz Laboratories	14	0.123 (4.025)	-0.070 (-0.949)	-0.007	0.900	1.536*
German Remedies	14	0.245 (3.247)	-0.311 (-1.690)***	0.125	2.857	1.168*
Bayer	14	0.031 (0.906)	0.240 (2.806)*	0.345	7.875**	1.622*
J.L. Morrison	14	-0.066 (-1.566)	0.379 (3.362)*	0.442	11.304*	1.312*
Albert David	14	0.117 (1.389)	-0.165 (-0.733)	-0.036	0.537	1.027
Geoffrey Manners	13	0.032 (1.704)	0.175 (3.092)*	0.416	9.561*	1.902*
Cynamid	12	0.009 (0.152)	0.174 (1.488)***	0.099	2.214	1.013
Infar	13	0.143 (1.014)	-0.050 (-0.247)	-0.093	0.061	1.837*
Hoechst	14	-0.002 (-0.019)	0.325 (1.330)	0.055	1.769	0.878
Parke Davies	14	0.014 (0.206)	0.221 (1.624)***	0.111	2.637	2.428*

contd ...

Company	N	Intercept	VI	$\bar{R}^2$	F	DW
Ciba Geigy	13	0.205 (2.852)	-0.201 (-1.319)	0.058	1.741	1.085*
Roche	14	0.111 (2.000)	-0.050 (-0.403)	-0.068	0.163	1.772*
E. Merck	14	0.131 (2.662)	-0.079 (-0.757)	-0.033	0.574	0.974
Roussel	14	0.089 (0.507)	0.084 (0.245)	-0.077	0.060	2.242*
Hindusthan Antibiotics	14	-0.156 (-1.599)	0.247 (1.282)	0.047	1.644	0.720
IDPL	14	0.012 (0.189)	0.042 (0.542)	-0.062	0.293	1.090*
Merck Sharpe Dohme	13	-0.106 (-0.792)	0.409 (1.569)***	0.108	2.464	1.165*
Burroughs Wellcome	14	0.124 (5.821)	-0.121 (-2.788)*	0.342	7.775**	2.134*
Curewel	10	0.138 (2.645)	-0.075 (-1.011)	0.002	1.023	1.529*

t-values are presented within parenthesis

* - significant at .01 level

** - significant at .05 level

*** - significant at .10 level

CHAPTER 6

PROFITABILITY AND ADVERTISING INTENSITY

6.1 INTRODUCTION

Advertising is a common feature in todays monopolistic markets. The main purpose of advertising it is commonly agreed is to increase or at the very least safeguard product sales. To quote, "The purpose of advertising given the specification of the product in all objective respects and given prices is to increase the number of consumers who will prefer that product to its competitors" [Hay and Morris 1979, p. 416]. Broadly, this can take place in two different ways. When the advertising is informative, consumers become aware of the existence and characteristics of all competing products and can therefore arrive at a rational choice. Alternatively, the firm influences choice by strengthening consumer preferences for its products through advertising. This would increase the psychic cost to the consumer of moving to an alternative product [Hay and Morris 1979].

The pharmaceutical industry is among the heaviest spenders on advertising and promotion. This industry had the highest ratio of promotion and advertisement cost to sales in the United States ranging from three to four times its research and development expenditure and in many cases exceeding the cost of

goods sold [Lall 1974]. Similarly, British pharmaceutical firms spend 14% - 15% of sales on promotion [Reekie 1970; de Jong 1981]. Indian pharmaceutical firms spent on an average 23.5% of ex-factory cost on selling and distribution which was the second most important item of post-manufacturing expenditure after trade commission [Narayana 1984]. H. W. de Jong puts the figure at 18% of sales turnover for the Indian industry [de Jong 1981].

The literature has extended some plausible explanations to justify such a high expenditure on promotion. One of them is provided by Nelson which however is disputed. According to him, the number of advertising messages provide information on relative product quality. Therefore, firms which have lower costs relative to the utility of their products will expand their output by increasing advertising expenditure and lowering price per unit of utility. Products of high utility, such as drugs, would therefore be advertised more [Nelson 1974]. This viewpoint is, however, disputed on the ground that such a relationship depended on the ease and ability of consumers to evaluate product quality. Where evaluation was difficult, firms with low quality products would advertise more to counter product disadvantages. Hence, a positive relationship between advertising and relative product quality need not be present in oligopolistic markets [Comanor and Wilson 1979].

A second possible reason is advanced by Lall. His explanation is that marketing is one aspect of drug manufacture where there exist significant economies of scale as opposed to production. This has therefore led to a greater emphasis on marketing with the consequent high allotments to promotion [Lall 1974].

The most plausible reason is advanced by Comanor, Cooper, and Reekie. They argue that price competition is not the major form of inter-firm rivalry. Rather it is a combination of the introduction of new products, presentation of existing products in a new and different form and high pressure promotion [Comanor 1964; Cooper 1966; Reekie 1970]. To quote Cooper "Substitute competition rather than orthodox price competition must lead to high advertising outlays - the lubricant of the entire system" [Cooper 1966, p. 207].

Promotion in the drugs and pharmaceutical industry is carried out mainly through detailmen or medical representatives supplemented by mailings, samples and advertisement in medical journals. While the representative is the principal means of launching a campaign and introducing the drug to the doctor, journal advertising is used as a reminder mechanism. Mailings are meant partly to keep the doctor informed of side effects, dosage levels and other details besides helping to keep the product in the doctor's mind [Cooper 1966]. The pharmaceutical market is different in that there is a complete

divorce in identity between the purchaser who is the patient and the choice-maker who is the doctor. The patient obeys his doctor and therefore his demand curve is fairly inelastic [Lall 1974; de Jong 1981]. The doctor is therefore the focus of advertising particularly in the case of prescription drugs which can be purchased only on the doctor's prescription. Prescription drugs are mostly prescribed by brand names, except in countries where brand names are legally prohibited, when they are prescribed by generic names. When the doctor prescribes by brand name he not only prescribes the drug but indirectly the manufacturer as well. Only when the prescription is generic can a pharmacist choose between rival manufacturers [de Jong 1981]. 'Over the Counter' drugs on the other hand do not require a doctors prescription and thus are more widely advertised like common consumer items.

From the manner in which advertising influences demand it may be perceived to have anti-competitive effects. Consequently, heavy spending on sales promotion by the pharmaceutical industry has been the subject of criticism from the early days of the Kefauver Committee hearings. Critics questioned the social gains resulting from this expenditure and charged that these outlays led to higher prices, a consequence of entry barriers which led to increased market power. It was argued that large outlays on sales promotion would have to be made by firms seeking entry. This entailed much higher ratios of selling

costs to sales compared with established firms. Without this scale of effort new firms would be foreclosed access to physicians who serve as proxies for consumers [Hugh Walker 1971].

As evidence of the existence of market power, critics pointed to the sharp difference in prices between products marketed under generic names and those sold under brand names. Promotion was said to introduce spurious product differentiation between drugs with similar pharmacological properties by promoting the brand image and securing its market even after the expiry of its patent. Reflecting on the methods adopted by multinationals the Hathi Committee says that large sums of money were spent by foreign companies in systematically training their 'medical detailers' and the general tone of detailing resorted to by them was that their product contained 'something plus' over products with identical composition marketed by Indian units and that their edge in quality was the outcome of their superior expertise and international standing. To quote Lall on the subject, 'There is no doubt that the drug companies' promotion serves the useful social function of bringing new discoveries to doctors' notice; there is, however, also no doubt that this promotion creates powerful monopoly positions, confuses the flow of correct information, may induce inappropriate prescribing and generally leads to considerable social waste" [Lall 1974, p. 154]. In other words promotion makes pharmaceutical markets' monopolistic.

These points of view on the anti-competitive nature of advertising and promotion in the pharmaceutical industry are, however, not shared by all. In the absence of price competition promotion was said to aid entry and facilitate substitute product competition. Lall himself in a later paper, pointed out that competition came from the entry of large firms as it would be backed by well known manufacturers' names and heavy promotion which cannot be provided by small manufacturers [Lall 1978]. Schwartzman [1976] found a correlation between innovation and promotion. Concluding that innovative firms spend larger sums on promotion than others he inferred that advertising was generally pro-competitive. This conclusion has been disputed on the grounds that firms active in the development and introduction of new products allocated a substantial volume of resources to research and development, and selling efforts. Consequently, firms that have high levels of promotional expenditures are those that introduce more new products. Therefore, such correlations indicate nothing about the relationship between selling efforts and competition [Comanor 1986].

These being the general tone of arguments on the nature of advertising and promotion in the pharmaceutical industry our attention would now shift to what the general literature has to say on the subject.

An early example is that of Bain who felt advertising raised entry barriers by lowering the cross-elasticities of demand between the products of established firms and those of new entrants through product differentiation [Bain 1956]. For the pharmaceutical industry this view is supported by atleast one study which found the degree of product differentiation to be a significant barrier to the entry of new firms [Yu 1934]. Telser, however, did not want to damn advertising in its entirety. To quote, "Thus there are some kinds of advertising that are compatible with, and indeed essential to competition - information on seller identity and reliability, price and terms of sale, and instruction on the use of the product. There are other kinds that only pay if the selling firm has some monopoly power, for example, if it is large relative to the total supply so that it benefits from increases in total demand. There are other kinds that themselves create monopoly power that otherwise would not exist" [Telser 1964, p. 541]. Some have argued that the dynamic effects of advertising would have anti-competitive effects only if there existed fundamental asymmetries in the demand functions between those of established firms and new entrants [Comanor and Wilson 1974; Schmalensee 1974]. Asymmetries are caused by consumer experience with the products of established firms'. Response to the advertising of established firms' and those of new entrants' would therefore vary. Established firms

would be in an advantageous position from being first movers and would inflict higher advertising costs on entrants, without fear of retaliation. They would also be in a position to earn higher returns without threat of entry. Others have argued that the nature of advertising, i.e., whether it is informative or persuasive, determines whether advertising is pro or anti-competitive. If advertising is informative, conveying to the consumer information on the qualities of a range of alternative products, their prices, other details etc., his loyalty to the products of particular firms would be limited thus promoting competition [Nelson 1970; Brozen 1974]. Still other writers hold the view that the competitive effects of advertising depend on whether the messages are true or false [Posner 1974]. Truthful advertising by providing information on the characteristics of the product would enable consumers to make a reasoned choice. Classifying messages as true [false], informative and persuasive may be easier said than done. Besides, messages could be true yet not reveal anything on the characteristics of a product [Turner 1974]. Lastly, the issue is not whether consumers are decieved but rather how they respond to the messages of alternate producers [Comanor and Wilson 1979].

The effects of heavy advertising may be different in different sectors of the economy. In the retail trade advertising is informative and tends to reduce market imperfections

while the opposite may be true in the consumer product industry [Kaldor 1950]. Empirical support for Kaldor's study comes from Benham [1972] and Boyer [1974]. Examining the price of eye-glasses in the United States, Benham [1972] found that where advertising was prohibited, the price of a pair of eye-glasses was more than double that in situations where advertising was not restricted. Boyer [1974] ran cross-section regressions with industry profit rate as the dependent variable and advertising - sales ratio, concentration ratios as the explanatory variables. For a sample of consumer goods industries he obtained positive significant coefficients for the advertising variable. For a sample of trade and service industries be obtained negative coefficients for the advertising variable.

As in the earlier discussion about the pharmaceutical industry, it is evident that no consensus has developed on the nature of the effect of advertising on competition. If advertising does have direct anticompetitive effects we can expect a positive relationship between profitability and advertising intensity. However, the relationship may also be negative if large firms achieve scale economies in national advertising within highly advertising intensive industries such as ours [Comanor and Wilson 1969].

In conclusion, therefore, it would be fitting to quote Comanor and Wilson, "The weight of available evidence is consistent with the hypothesis that heavy advertising can have

substantial anticompetitive consequences. However, because the distribution of advertising intensities is highly skewed, there is no indication that these effects are pervasive throughout the economy or even within the manufacturing sector. Rather, they appear to be concentrated in a small number of industries with high advertising - sales ratios and/or high absolute levels of advertising per firm" [Comanor and Wilson 1979, p. 470].

The nature of advertising, whether it aids or affects compeitition has been the subject of several empirical studies. The next section presents the findings of these studies in detail.

6.2 REVIEW OF EMPIRICAL EVIDENCE

Various methods have been used to study the nature of advertising. One method has been to calculate the correlation between advertising - sales ratios and concentration ratios, where concentration ratios are used as a measure of monopoly. An early study of this kind was by Telser. He found a low correlation between these two variables [Telser 1964]. Other important studies of this kind are Mann, Henning and Meehan [1967], Telser [1969], and Strickland and Weiss [1976]. Concentration ratios have been critized as a poor measure of monopoly which depended on the height of entry barriers and other

factors and therefore lending itself to a poor test of the effect of advertising on competition [Comanor and Wilson 1979, p. 458]. This apart, the focus of this study being at the firm-level the purpose would not be served by such a study which is generally conducted at the industry level.

A second method, although at a more micro-level, has been to study the impact of advertising intensity on the demand elasticities of individual brands [Lambin 1976]. This method has not been popular because of the difficulties involved in directly estimating the impact of advertising on demand elasticities. Besides, since Dorfman and Steiner [1954] it has been recognized that the optimal level of advertising expenditure also depended on the demand elasticities facing the firm. So problems of causality were involved.

The difficulties associated with the above methods led to the examination of the relationship between profitability and advertising. In the pharmaceutical industry, as in the general case, high accounting profit rates have been taken as evidence of monopoly power [Comanor 1964, p. 380; Schifrin 1967, pp. 908-12]. Studies which sought to correct accounting profits for the investment character of advertising and research have also implicitly acknowledged the validity of profit rates as a measure of monopoly [Kenneth Clarkson 1977, 1979]. This is so since in long run equilibrium profit rates should be equalized across firms and risk adjusted profit rates across

industries. Where differences in profitability persist it indicates failure of the competitive mechanism. An examination of the relationship between profitability and advertising would therefore determine whether advertising reduced competition.

Studies' involving the relationship between profitability and advertising have been conducted both at the firm and at the industry level. Among studies which were conducted at the firm-level are the U.S.F.T.C. [1969], Imel and Helmberger [1971], Shepherd [1972, 1975], Ravenscraft [1983], all of which introduced the advertising-sales ratio among other variables influencing firm-level profitability, and Vernon and Nourse [1973].

The U.S.F.T.C. study was done with a sample of 97 American food manufacturing companies. Results indicated a strong positive relationship between profit rate and advertising intensity. Imel and Helmberger's study of the food processing industry also yielded similar results. Shepherd's study, with Fortune 500 companies, indicated that advertising intensity was positive and significant when a general sample of companies was used. When the study was repeated on a sample of consumer goods firms the effect of advertising intensity was found to be very much lower than in the general case. Further, the quantitative importance of advertising intensity was relatively small in comparison to other determinants such as

market-share. He, therefore, concluded that only limited evidence was found of its role as an entry barrier. The difference in the performance of the advertising variable between the two samples, he felt, indicated a negative intra-industry association within extremely advertising intensive industries. Vernon and Nourse estimated different regressions equations in which the profit of a firm was presumed to depend on industry as well as own advertising intensity and other variables. The sample consisted of large American corporations manufacturing consumer non-durables. When introduced separately, both advertising variables were positive and significant. When introduced together, however, own advertising intensity became insignificant. These results were seen as evidence that advertising served as a barrier to entry into the industry. Ravenscraft's study found that line of business advertising intensity [introduced in his regression equation along with line of business R and D intensity and assets to capture the effects of differential efficiency in their utilization] had a negative influence on line of business profits which was interpreted as suggesting an inefficient use of the investment strategy variable beyond average industry levels.

Prominent among studies which examined this relationship at the industry-level are those by Comanor and Wilson [1967] and Miller [1969]. Both these studies found a positive and

statistically significant effect for industry advertising on industry profitability. The relationship held for different sample groups [Miller 1969] and under different specifications [Comanor and Wilson 1967]. Both the studies viewed advertising as a proxy for product differentiation which raised entry barriers leading to increased market power.

Ravenscraft [1983], and also Amato and Wilder [1985] introduced industry advertising intensity to capture the effect of industry level barriers to entry in regressions explaining firm-level profit rates. Both studies found a positive and significant influence for industry advertising intensity on firm-level profit rates.

Taking into consideration the direction of causality in advertising-profitability relationships, Comanor and Wilson estimated a simultaneous equations model with profit rate as the dependent variable explained by advertising intensity and other market structural variables in one equation. The second equation had advertising intensity as the dependent variable explained by the profitability margin and other factors. The advertising coefficient in the profitability equation remained statistically significant in two of the four models tested. Further, the simultaneous equation estimates of the effects of advertising on profits were larger than the OLS estimates in all four models. They concluded that even after the effect of profitability on advertising was accounted for, advertising

intensity remained an important factor in the determination of profitability [Comanor and Wilson 1974].

Lastly, some studies like Weiss [1969], Bloch [1974] and Ayanian [1975] viewed advertising as an investment in intangible capital which should be amortized over time. Profit rates had to be adjusted to take account of the intangible assets created by advertising. For this to be done appropriate depreciation rates for advertising capital had to be arrived at. The depreciation rates were dependent on the time-span over which advertisement remained effective. There being no set method to arrive at the right depreciation rate, results have tended to depend on the depreciation rate chosen. Low depreciation rates used both by Bloch and Ayanian were said to be the reason for the observed relationship between advertisement and profitability being insignificant [Comanor and Wilson 1979, pp. 464-465]. On the other hand, Weiss used a higher depreciation rate and found that the estimated advertising coefficients were statistically significant. Reviewing the literature on the subject Comanor and Wilson had this to say "When reasonable estimates of depreciation rates of advertising capital are used to adjust rates of return, the finding that advertising has a significant, positive impact on profitability is supported. We therefore conclude that this econometric result cannot simply be attributed to accounting biases related to the expensing of advertising" [Comanor and Wilson 1979, pp. 466-467], which

implies that using unadjusted accounting rates of return would not alter the nature of the relationship between profit rates and advertising intensity.

Note : It should not escape one's eye that no Indian study has been referenced. There is an acute shortage of studies on advertising in the Indian context. This study it is hoped is a beginning in examining this aspect in the Indian industry.

6.3 THE EMPIRICAL ANALYSIS : SPECIFICATION OF THE MODELS

The accepted approach is adopted to study the effects of advertising. Profitability is regressed on a measure of advertising intensity using two separate linear models[1] which are framed as under :

$$P_1 = a + b_1 ADVINT + u \qquad (6.1)$$

$$P_2 = a + b_1 ADVINT + u \qquad (6.2)$$

where P_1 and P_2 are the usual measures of profitability, and

ADVINT represents advertising intensity defined as the ratio of firm-level advertising expenditure to total sales turnover.

u is the random disturbance term.

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1. A quadratic fit of the form $P_i = a + b_1 ADVINT + b_2 (ADVINT)^2$, $i = 1,2$, was also tried. In a good majority of the regressions the coefficient of the quadratic term was insignificant. As the quadratic fit did not show any improvement over the linear fit the linear fit was retained.

The sample consisted of thirty-three firms. The number fluctuated in the cross-section study due to the familiar problem of infrequent reporting of advertisement expenditures incurred. The sample for the time-series section was limited to those firms for which atleast ten years time-series data on advertising expenditures in the period 1970-83 was available. This reduced the number of firms in the sample used in the time-series study to thirty.

The data considered as advertisement expenditure was listed under various heads in the Profit and Loss accounts of different firms. Some firms listed them as advertisement expenditure, others under advertisement and sales promotion expenditure, promotional expenses, publicity expenses, propaganda expenses or expenses on medical information. It was impossible to distinguish as to what expenditure went under these different heads. As mentioned earlier, media advertisement expenditure does not amount to much in the pharmaceutical industry except in the case of 'over the counter' drugs. Medical representatives being the most important via media of channeling information on various medical products, one would expect the expenditure incurred on them, such as their salaries, be rightfully included under advertisement expenditure. But these are more likely to be listed under wages and salaries. Having no independent means of verification of the information listed under the common head 'advertising expenditure', it is accepted as such although the feeling is that they are understated.

6.4 REGRESSION RESULTS : CROSS-SECTION

The results of the cross-section analysis are presented in Tables 6.1(a) and 6.1(b). Table 6.1(a) presents the results of the regression of P_1 on ADVINT using model 6.1. ADVINT is found to be negatively related with P_1 in five regressions. ADVINT is however significant in only one regression [year 1979], when weighted least squares are used to re-estimate the equation suffering from the presence of heteroscedasticity. The weight used is the square root of advertising intensity.[2] The obtained F-statistic is also significant at the .05 level in this regression. Except in the year 1979, the $\bar{R}^2$'s indicate that advertising intensity does not explain the variation in P_1 in any other regression. These results can, therefore, be taken as only weak evidence of the existence of an inverse relationship between profitability and advertising intensity. Even when P_2 is the dependent variable as in model 6.2 similar results are obtained. This can be seen in Table 6.2(b). ADVINT is by and large negatively related with P_2 but is insignificant in every regression. So are the F-statistics. Again, there is

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2. The surmise is that the more advertising intensive firms would face less uncertainties in the market because of their effective product differentiation. Consequently, variance of profit rates would be inversely related to advertising intensity and therefore so would the sum of squares of residuals from the least squares regression. Square root of advertising intensity is therefore used as the weighting variable.

found weak evidence of the existence of a negative relationship between profitability and advertising intensity.

6.5 REGRESSION RESULTS : TIME-SERIES

Tables 6.2(a) and 6.2(b) present the results of the time-series analysis with models 6.1 and 6.2. Table 6.2(a) presents the results of the analysis using model 6.1. It is found that ADVINT is positively related with P_1 in nineteen cases and negatively related with P_1 in eleven cases. ADVINT is however significant in only thirteen regressions, in ten of which ADVINT is positive and in three cases negative in sign. The obtained F-statistic is significant in nine cases. The $\bar{R}^2$'s are high in cases such as Bayer and Geoffrey Manners at 0.758 and 0.795 respectively, and take more moderate values in some other cases. However, in quite a few cases it can be seen that advertising intensity does not have any appreciable influence on profitability. Some plausible reasons may be cited here by way of an explanation.

Firstly, it may be that some of these firms were only indulging in defensive advertising to protect their market positions against competition and were therefore in no position to increase their profit margins. Hence, P_1 may have remained unaffected by advertising intensity. Alternatively, the firms were only undertaking reminder advertising. In markets characterized by low product turnover such as the Indian pharmaceutical industry the advantage of being a first-mover are high.

Customer experience ensures loyalty and firms satisfied with their profitability need undertake only reminder advertising to keep their products in the customers mind.

The third possibility is that advertising campaigns were aimed at sales maximization rather than profit maximization. In such a case also advertising intensity is unlikely to affect the profitability on sales.

Fourthly, price and profit controls imposed by the overnment on the industry may have prevented the emergence of a significant relationship between profitability and advertising intensity. For instance, the Drug (Prices Control) Order 1979, classified all formulations into four categories and fixed separate mark-ups on ex-factory cost for each category. It also fixed an overall profit ceiling of 8%-13% pre-tax profitability on formulation sales. The mark-ups were to meet distribution, promotion and trade commission expenses, and charges on freight and interest. The balance after meeting these expenses constituted the profits. As the mark-ups varied by the category of formulations produced by the firm, the degrees of freedom enjoyed by them in appropriating the market power generated from advertising through an increase in selling prices were different depending on the category of products produced. In any case even this may not have been possible because for many pharmaceutical products the overnment fixes leader prices which is the maximum that may be charged. Only

in the case of category IV products, for which there are no prescribed prices or mark-ups, would the firms have been able to utilize their market power generated by advertising to increase prices and consequently their profit margins. Even in this case the ceilings prescribed over the profitability on sales may not have allowed much freedom to manoeuvre. However, where the profitability ceiling has not been attained there is scope to improve profit margins through a reduction in the average advertisement expenditure by spreading it over a larger volume of sales. This reduces the proportion of mark-up allotted to advertising and the profit margins may thus register an increase provided that the proportions of the mark-ups allotted to the other post-manufacturing expenses dont increase. An examination of the data on advertising intensity shows this may have been possible. It is seen that advertising intensity declined over the time-period in most cases. To give some prominent examples, advertising intensity declined from 14.7% to 5.4% over the time-period in the case of Amrutanjan, from 7.6% to 1.7% in the case of Searle, from 16.4% to 6.4% in the case of Richardson Hindusthan and from 13.6% to 7.9% in the case of Geoffrey Manners. The major reason for this decrease is the disproportionately large increase in sales turnover which is in the denominator of the measure of advertising intensity. It can be said that pharmaceutical firms experienced increasing returns to advertisement expenditure and were very successful

in shifting their individual demand curves by taking advantage of external economies such as the expansion in the overall pharmaceutical market. Given that advertising intensity declined it is noticed that in those cases where ADVINT is significantly negative the firms in question had experienced an increase in P_1. To give some examples, P_1 increased from 3.8% to 5.7% in the case of Ciba-Geigy as its advertising intensity fell from 1.7% to 1.4%. In the case of J.L.Morrison P_1 increased from -2.6% to 2.9% while its advertising intensity fell from 1.75% to 1.24%. On the other hand, the positive significant relationship between P_1 and ADVINT is the result of P_1 having decreased even though advertising intensity also declined. The decrease in P_1 may be the result of an overcompensating increase in the other expenses met out of the mark-up or an increase in production cost itself when selling prices were fixed thus negating the gain from the decrease in average advertising expenditure. It may also be the result of a conscious decision to settle for lower profit margins in the present and expanding sales with an eye on the future.

Table 6.2(b) presents the results obtained with model 6.2. It can be seen from the table that ADVINT is positively related with P_2 in eleven regressions and negatively related with P_2 in nineteen regressions. ADVINT is however significant in only fourteen regressions among which it is negative in eleven regressions and positive in three regressions. The model has

done well in quite a few of these cases with the F-statistic being significant in eleven regressions. The R^2 is quite high in a few regressions such as Boots, Richardson Hindusthan, Hoechst and Curewel where it is greater than 0.50.

Comparing these results with the ones obtained with model 6.1 which were presented in Table 6.2(a) shows that ADVINT continues to be positive and significant when either model is used to fit the data in three cases only, viz., Bayer, Geoffrey Manners and Hoechst. In the cases of Unichem Laboratories and Richardson Hindusthan, ADVINT is positive and significant when model 6.1 is used but is negative and significant when model 6.2 is used to fit the data. In other cases such as Reckitt and Colman, Sandoz, Cynamid and Hindusthan Antibiotics ADVINT which is positive and significant when model 6.1 is used remains positive but is insignificant when model 6.2 is used. In the case of Alembic ADVINT becomes negative and insignificant when model 6.2 is used. Sign changes are also to be noticed in the case of companies like Amrutanjan, Ranbaxy, German Remedies etc., where ADVINT is positive and insignificant when the model used is 6.1 but is negative and insignificant when model 6.2 is used. In the case of Boots ADVINT even becomes negative and significant. On the other hand cases where ADVINT is negative and significant when model 6.1 is used to fit the data continue to be negative and significant when model 6.2 is used [for example J.L. Morrison,

Ciba-Geigy, and Curewel]. Similarly, there are cases where ADVINT is negative and insignificant when model 6.1 is used and negative and significant when model 6.2 is used [for example Duphar Interfran, Glaxo Laboratories, Searle, E. Merck etc.].

If P_1 is considered to be a profit margin on sales whereas P_2 is the rate of return on assets it becomes clear that those companies' in whose cases ADVINT is negative and significant under either specification had managed to improve not only their profit margins because their average advertising expenditure declined, but as a consequence of the increasing returns to advertising expenditure, had shifted their demand curves enough to increase the absolute sum of profits, resulting in an increasing P_2, the rate of return on assets.

There are also companies in whose cases decreasing advertising intensity did not have any effect on the profit margin, as indicated by an insignificant ADVINT when model 6.1 is used, but where increasing returns to advertising led to increasing return on assets as shown by a negative significant ADVINT when model 6.2 is used. A few examples will be in order here. In Duphar Interfran's case advertising intensity decreased from 7.8% to 2.8% over the time period. Over the same time period P_2 increased from 6.8% to 8.8%. Similarly, in the cases of Glaxo Laboratories and Searle advertising intensity decreased from 2% to 1.5% and from 7.6% to 1.8% respectively while P_2 increased from 7.1% to 8.9% and 10.3% to 13.7% respectively.

Using similar reasoning, it can be said that the companies in whose cases ADVINT is positive and significant when model 6.1 is used and negative significant when model 6.2 is used, viz., Unichem Laboratories and Richardson Hindusthan, found their profit margins decreasing inspite of decreasing advertising intensity, but the increasing returns to advertising expenditure resulted in higher returns on assets. In those cases such as Bayer and Geoffrey Manners where ADVINT remains positive and statistically significant regardless of the model used it may be said that they were unsuccessful in shifting their demand curves enough to compensate for decreasing profit margins and consequently the return on assets also declined. For instance, P_2 declined from 15% to 12% and from 10% to 5% in the cases of Bayer and Geoffrey Manners respectively. Finally, there are cases such as Amrutanjan, Rallis, Pfizer etc., where advertising intensity affects neither P_1 nor P_2 as revealed by an insignificant ADVINT.

6.6 STABILITY IN PROFIT MARGINS AND ADVERTISING

An additional hypothesis that needs testing is whether advertising protected profit margins from erosion because of increased competition. In many cases it was seen that advertising intensity did not show any significant relationship with the profit margins. One explanation it was felt may have been that firms indulged in defensive advertising. Did defensive

advertising protect profit margins? To verify if this indeed is the case the variance of the profit margins for each firm between the years 1973-81[3] is regressed on their advertising intensity computed for the same period. The results are contained in Table 6.3. They show only weak evidence to the effect that advertising led to stability in profit margins. ADVINT is significant only at the .10 level. It seems that advertising may have been slightly successful in stabilizing the profit margins of some of the firms in the sample.

6.7 CONCLUDING REMARKS

This study does not yield evidence suggesting that advertising in general had anticompetitive effects. No evidence is found which indicates that advertising gained firms some market power enabling them to price in a monopolistic manner. Evidence indicating the presence of market power can be said to exist if there was present a positive and statistically significant relationship between the profit margins and advertising intensity. But the results of the cross-section analysis show a weak negative relationship which is more in keeping with the results obtained by Ravenscraft [1983]

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3. This period is chosen as it yields the maximum number of firms for which data is available for the entire period. If the time-period were longer some more firms would have to be dropped from the sample.

The time-series analysis showed that a few firms may have managed to improve their margins of profit more due to the decline in the average cost of advertising by spreading it over a larger volume of sales than because of market power gained by advertising. Price controls also ensured that pricing in a monopolistic manner was not possible. At the same time government policies may have compelled firms to adopt a policy of sales maximization. Advertising helped firms in shifting demand successfully. There generally existed increasing returns to advertising expenditure as indicated by advertising intensities decreasing inspite of increasing advertising expenditure. The strategy to shift demand was found to be successful in quite a few cases. The analysis showed that this strategy allowed them to maintain and in some cases even increase the return on assets inspite of falling profit margins.

Table 6.1(a)

Regression Results (Cross-section): Model 6.1

Year	N	Intercept	ADVINT	$\bar{R}^2$	F	DW	B-P Statistic
1970	15	0.052 (2.977)	-0.086 (-0.408)	-0.063	0.167	2.640*	0.886
1972	24	0.033 (1.420)	0.054 (0.149)	-0.044	0.022	1.827*	6.331
1974	31	0.026 (1.460)	0.082 (0.327)	-0.031	0.107	1.704*	10.126*
	(a)	0.038 (3.903)	-0.120 (-0.873)	-0.007	0.763	1.448*	
1977	33	0.041 (4.212)	-0.226 (-0.876)	-0.007	0.767	1.967*	0.166
1979	33	0.036 (3.429)	-0.033 (-0.107)	-0.031	0.011	1.681*	10.017*
	(a)	0.049 (7.026)	-0.313 (-2.406)**	0.130	5.791**	1.972*	
1981	30	-0.001 (-0.036)	0.600 (0.849)	-0.009	0.721	1.460*	7.225*
	(a)	0.026 (1.518)	-0.069 (-0.185)	-0.034	0.034	1.937*	
1983	14	0.020 (0.619)	0.286 (0.217)	-0.079	0.047	1.977*	2.777

t-values are presented within parenthesis ; (a) - weighted least square estimates
* - significant at .1 level ; ** - significant at .05 level

Table 6.1(b)

Regression Results (Cross-section): Model 6.2

Year	N	Intercept	ADVINT	$\bar{R}^2$	F	DW	B-P Statistic
1970	15	0.069 (4.058)	0.106 (0.525)	-0.054	0.276	2.279*	1.222
1972	24	0.084 (4.396)	-0.112 (-0.379)	-0.038	0.143	2.031*	2.888
1974	31	0.076 (5.533)	-0.004 (-0.015)	-0.035	0.0002	1.487*	8.360*
	(a)	0.088 (7.796)	-0.179 (-1.155)	0.011	1.336	1.658*	
1977	33	0.095 (7.276)	-0.169 (-0.491)	-0.024	0.241	1.874*	1.034
1979	33	0.098 (8.365)	-0.199 (-0.578)	-0.021	0.334	1.647*	7.216*
	(a)	0.097 (9.923)	-0.170 (-0.933)	0.004	0.871	1.829*	
1981	30	0.088 (6.299)	-0.068 (-0.154)	-0.034	0.023	1.762*	0.001
1983	14	0.094 (4.150)	0.094 (0.104)	-0.082	0.010	2.103*	1.525

t-values are presented within parenthesis ; (a) indicates weighted least square estimates

* - significant at .01 level

Table 6.2(a)

Regression Results (Time-series): Model 6.1

Company	N	Intercept	ADVINT	$\bar{R}^2$	F	DW
Duphar-Interfran	12	0.041 (4.946)	-0.215 (-1.287)	0.056	1.658	1.511*
Glaxo Laboratories	11	0.047 (3.693)	-0.125 (-0.179)	-0.120	0.032	1.468*
Boehringer Knoll	10	-0.004 (-0.229)	0.734 (1.329)	0.078	1.768	1.161*
Amrutanjan	13	0.018 (3.058)	0.086 (1.267)	0.048	1.606	1.644*
Rallis	11	0.012 (2.745)	-0.306 (-0.616)	-0.066	0.379	1.553*
Searle	13	0.099 (4.135)	-0.102 (-0.174)	-0.087	0.030	1.047*
Unichem Laboratories	12	-0.016 (-1.352)	0.460 (3.262)*	0.467	10.643*	1.004
Reckitt and Colman	12	0.026 (4.479)	0.755 (3.651)*	0.528	13.334*	1.670*
Pfizer Laboratories	12	0.056 (5.634)	0.703 (0.522)	-0.078	0.273	1.680*
Boots	11	0.035 (3.473)	0.159 (0.515)	-0.079	0.265	0.929
Alembic	11	0.004 (0.394)	0.579 (1.795)**	0.181	3.224	1.014*
Richardson Hindusthan	14	0.009 (0.899)	0.307 (2.817)*	0.348	7.940**	1.004
Cipla	11	0.008 (0.215)	0.142 (0.236)	-0.104	0.055	2.345*
Ranbaxy Laboratories	11	0.042 (2.037)	0.610 (1.088)	0.020	1.183	1.317*

contd ...

Company	N	Intercept	ADVINT	$\bar{R}^2$	F	DW
Sandoz Laboratories	12	0.021 (4.080)	0.699 (1.415)***	0.083	2.003	1.816*
German Remedies	11	0.032 (3.880)	0.524 (0.921)	-0.015	0.849	2.158*
Bayer	13	0.004 (0.401)	4.531 (6.221)*	0.758	38.703*	1.662*
J.L.Morrison	13	0.040 (2.915)	-1.742 (-2.049)**	0.210	4.199	1.742*
Albert David	11	-0.002 (-0.060)	0.124 (0.189)	-0.106	0.035	1.672*
Geoffrey Manners	13	-0.008 (-1.445)	0.402 (6.911)*	0.795	47.770*	1.611*
Cynamid	10	0.016 (0.805)	1.614 (3.481)*	0.552	12.120*	1.158*
Infar	13	0.072 (4.312)	-0.665 (-0.572)	-0.059	0.327	0.880
Hoechst	12	-0.018 (-0.951)	8 302 (4.334)*	0.617	18.787*	1.804*
Ciba Geigy	13	0.074 (9.121)	-1.612 (-2.562)**	0.316	6.564**	1.548*
Roche	11	0.040 (2.966)	0.413 (0.697)	-0.054	0.486	1.593*
E. Merck	14	0.027 (3.170)	-0.078 (-0.271)	-0.076	0.073	1.088*

contd ...

Table 6.2(b)

Regression Results (Time-series): Model 6.2

Company	N	Intercept	ADVINT	$\bar{R}^2$	F	DW
Duphar Interfran	12	0.134 (8.290)	-0.860 (-2.636)**	0.351	6.950**	2.819*
Glaxo Laboratories	11	0.129 (7.743)	-2.157 (-2.457)**	0.358	6.037**	1.507*
Boehringer Knoll	10	0.069 (3.233)	0.501 (0.783)	-0.044	0.613	1.158*
Amrutanjan	13	0.088 (6.665)	-0.169 (-1.117)	0.020	1.248	1.336*
Rallis	11	0.102 (8.426)	-1.441 (-1.109)	0.022	1.231	3.271*
Searle	13	0.190 (10.819)	-0.841 (-1.960)**	0.191	3.844	1.873*
Unichem Laboratories	12	0.149 (7.287)	-0.753 (-3.199)*	0.456	10.233*	2.419*
Reckitt and Colman	12	0.033 (0.184)	4.927 (0.751)	-0.041	0.564	2.179*
Pfizer Laboratories	12	0.090 (6.170)	1.739 (0.758)	-0.040	0.574	1.232*
Boots	11	0.148 (13.109)	-1.251 (-3.623)*	0.548	13.128*	1.366*
Alembic	11	0.092 (7.039)	-0.427 (-1.049)	0.010	1.102	1.368*
Richardson Hindusthan	14	0.180 (8.413)	-1.004 (-4.005)*	0.556	16.043*	1.409*
Cipla	11	0.022 (0.366)	0.726 (0.732)	-0.048	0.536	2.406*
Ranbaxy Laboratories	11	0.141 (3.603)	-0.924 (-0.587)	-0.078	0.345	1.679*

contd ...

Company	N	Intercept	ADVINT	$\bar{R}^2$	F	DW
Sandoz Laboratories	12	0.089 (4.354)	0.701 (0.372)	-0.084	0.138	1.370*
German Remedies	11	0.140 (7.404)	-0.970 (-0.884)	-0.024	0.782	2.193*
Bayer	13	0.094 (7.583)	2.430 (3.286)*	0.449	10.798*	2.022*
J.L. Morrison	13	0.102 (4.675)	-2.223 (-1.635)***	0.122	2.673	1.554*
Albert David	11	0.057 (0.961)	-0.540 (-0.540)	-0.076	0.291	1.488*
Geoffrey Manners	13	0.039 (2.242)	0.507 (3.013)*	0.402	9.081**	1.996*
Cynamid	10	0.062 (1.499)	1.078 (1.158)	0.036	1.343	1.021*
Infar	13	0.116 (6.231)	-0.921 (-0.811)	-0.031	0.659	1.621*
Hoechst	12	0.043 (1.659)	10.278 (3.641)*	0.527	13.262*	1.854*
Ciba Geigy	13	0.169 (8.187)	-4.720 (-2.940)*	0.389	8.647**	1.980*
Roche	11	0.094 (4.846)	-0.471 (-0.553)	-0.074	0.305	1.959*
E. Merck	14	0.109 (8.974)	-0.574 (-1.415)***	0.071	2.003	1.182*
Hindusthan Antibiotics	12	-0.070 (-1.112)	0.196 (0.292)	-0.100	0.085	1.608*

contd ...

Company	N	Intercept	ADVINT	$\bar{R}^2$	F	DW
IDPL	13	0.015 (0.371)	1.035 (0.425)	-0.080	0.181	0.992
Burroughs Wellcome	11	0.097 (9.193)	-0.773 (-2.764)*	0.399	7.642**	2.316*
Curewel	10	0.145 (10.836)	-2.128 (-4.994)*	0.726	24.948*	2.518*

t-values are presented within parenthesis

* - significant at .01 level

** - significant at .05 level

*** - significant at .10 level

Table 6.3

Stability in Profit Margins and Advertising

N	a	ADVINT	$\bar{R}^2$	F
31	0.002 (2.326)	-0.042*** (-1.472)	0.037	2.167

t- values are presented within parenthesis

*** - significant at .10 level

CHAPTER 7

PROFITABILITY AND GROWTH

7.1 INTRODUCTION

Maximizing the growth of the firm is an important alternative objective to profit maximization. Baumol [1962] feels that it may even be the primary objective. To quote, "Expansion is a theme which (with some variations) is dinned into the ears of stockholders, is constantly reported in the financial pages and in the journals devoted to business affairs. Indeed, in talking to business executives one may easily come to believe that growth of the firm is the main preoccupation of top management" [Baumol 1962, p. 1078]. Firms in the pharmaceutical industry in India have not been an exception when it comes to growth. To give an idea, only one firm in the sample had managed not to double its sales turnover between 1970 and 1983. Eight firms had increased their sales turnover to atleast ten times their initial turnover, seven firms to five times, five firms to four times, eight firms to three times while the rest had atleast doubled their initial turnover. The operational side of the firm measured by total assets also witnessed rapid growth. Five firms increased their total assets to ten times the initial figure during the same period, four firms to atleast five

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7.1 INTRODUCTION

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times, two firms to four times, nine firms to three times while the rest atleast doubled their assets. Only two firms managed not to double their assets.

In modern corporations characterized as they are by a separation of the ownership from the management, the desire for growth stems chiefly from the desire for things such as salary, status, power and security on the part of the management. Other factors responsible for the growth in size include survival of the firm, reduction of the variability in returns, reducing uncertainty and protection from competitive pressures which are advantages frequently possessed by firms of large size. These factors may be more broadly characterized as security considerations [see Hay and Morris 1984, Chp. 8 for a thorough review]. Penrose had, on the other hand, visualized growth as the profitab e utilization of idle assets [Penrose 1959]. Idle assets were picturized as arising from three sources :

(a) Underutilization of indivisible resources.

(b) Increased specialization of the managerial function leading to some knowledge, experience and skill being underexploited.

(c) The creation of new productive resources through the acquisition of new skills and information when operating or expanding so that these new resources can generate more services.

Briefly, this is how it proceeds. As operations become routine and hence less demanding on managerial services, the excess managerial capacity thus created could be released for expansion without any fall in the efficiency with which existing operations are run. Continuous growth can, therefore, be generated by always having a fixed managerial service for expansion, through time. It has been shown that a substantial rate of growth may be required even if growth maximization were not among the firm's objectives [Baumol 1967, Chp. 10]. The reasoning is that growth helps provide the firm the finances required for pursuing its objectives by increasing the size of its profits. Baumol shows this to be true under steady state conditions by considering various objectives such as maximizing the present value of total company profits, sales maximization and maximizing the present value of future expected sales. What is important is the choice of the rate at which to grow. This is tempered by many considerations. The conflict of objectives that may exist between owners and managers in modern corporations leads to the management pursuing its objectives subject to constraints such as a certain minimum level of market valuation to be maintained or a certain level of profit that has to be earned. Another constraint is capital. Capital is raised both through the retention of profits and by the sale of stocks and bonds. However, the market valuation of the firm

suffers as the retention ratio increases. The lower the valuation ratio [stock market value to asset value] the greater would be the threat of takeover. So managers choose the highest sustainable rate of growth subject to the constraint that the valuation ratio does not fall below the prescribed lower limit [Williamson 1966; Heal and Silbertson 1972]. Baumol [1967] suggested that firms would maximize the rate of growth [of sales revenue] subject to a minimum profit constraint, profit being a means of obtaining capital to finance expansion plans. Marris [1964] had suggested earlier that firms maximized growth subject to a limitation on the amount of new investment financed per unit of profit earned thus maintaining their market valuation, for beyond this the risk of takeover became considerably high. In any eventuality, Heal and Silbertson [1972] showed that under steady state conditions the growth rate chosen by the growth maximizer would be higher than the growth rate chosen by the profit maximizer or its 'logical equivalent' in a multi-period model, the maximization of the present discounted value of future dividends.

7.2 PROFITABILITY AND GROWTH

Different opinions prevail on the effect that growth maximization has on the profits earned by the firm. Baumol felt that pursuance of the growth maximization objective

would reduce the profits earned by a firm [Baumol 1962, 1967]. But Williamson showed that the profit maximizer would select the same output level as the growth maximizer and both would seek the highest possible level of profits [Williamson 1966]. Williamson pointed out that Baumol erred due to his inability to distinguish between the firm's profit [Total revenue less costs attributed to maintaining current output] and profitability [Total revenue less all costs including expansion costs]. Whereas profits or net revenue would be equal should the firm pursue either objective, profitability would decrease if the firm pursued a growth maximization objective. The error on Baumol's part had arisen on account of an inadequate specification of the profit-demand relation when he assumed that the firm would choose that level of sales which compromised between the desire to earn profits to finance its expansion and the desire to grow further which in turn, he assumed, would cause a reduction in its profits. This Williamson pointed out was a mistake. Marris [1964] had in order to show that pursuance of growth maximization objective reduced profits emphasized on growth through diversification. He also developed a relationship between current price, marketing expenditure and the future rate of growth which enabled him to show that growth maximizers will not maximize profits. He cited three reasons for profits to decline due to growth via diversification. Successful diversification requires :

(a) Higher expenditures on advertising and other promotional activities.

(b) Higher levels of expenditure on research and and development.

(c) Lower prices to attract more customers.

Expenditure on advertising, and research and development result in a lower rate of return on capital through either an increase in the capital-output ratio or through a decrease in the profit margin depending on whether one considers them capital or current expenditures. The capital-output ratio may also increase due to errors in investment planning and due to a decrease in managerial efficiency as the rate of growth increased. Even within the Penrosian framework there is the possibility that profits may decline as the firm grows at a fast rate. Problems in co-ordinating new activities with each other and integrating them into the firm increase. This increases the managerial services that have to be rendered leading to a fall in managerial efficiency with the result that profits may decline in a rapidly growing firm.

The relationship between profitability and growth may be of a simultaneous nature. Simultaneity in the relationship was first chronicled by Downie [1958]. In his model, growth rate is a positive function of profitability since the rate of capacity expansion varies directly with the rate of profit whereas profitability is a negative functions of growth since

the rate of profit is inversely related to the growth of demand beyond a certain point. This occurs as beyond some point, attraction of further customers will only be at the expense of the profit rate. The model $G = f(P)$ is expected to be identified rather than the model $P = f(G)$, where G is the rate of growth and P is the profit rate. The relationship $G = f(P)$ is basically a supply of capital function which depends on the conditions in the capital market while the relationship $P = f(G)$ is a demand-growth function dependent on conditions specific to each firm such as the differing capabilities of management, market conditions and so on. On the other hand, the effect of profitability on growth will tend to be relatively similar between firms since growth is determined partly by the capital market which is independent of the characteristics of the individual firms. Therefore, the variance of the error term in $G = f(P)$ is likely to be much smaller than the variance of the error term in $P = f(G)$. Therefore, if perfect capital markets exist the equation $G = f(P)$ is expected to be identified rather than the equation $P = f(G)$ [Singh and Whittington 1970; Eatwell 1971].

Be that as it may, the interest here is not in the determinants of growth but rather on how growth affects profitability. In this the guidelines have been the Marris model but with an essential difference. In the Marris model, growth forms the dependent variable while the profit rate is the

explanatory variable. In this study, the profit rate forms the dependent variable whereas growth of the firm is the explanatory variable. However, like Marris it is proposed to specify the effects of growth in demand on profitability and the growth in supply on profitability separately to study their independent influences. Marris provides useful hints on the direction of the profitability-growth relationship. He feels that at very low growth rates the relationship between growth of demand and profitability would be direct. At small levels of growth the profit margin may increase because of the relatively high margins a firm can earn in new markets as compared to its existing saturated markets. Competition, however, whittles down the margin later. A small rate of growth ensures that there will always be some products in the temporary monopoly stage earning it higher profit margins than if there were no growth. Secondly, a zero growth rate would present a dull and rigid business environment which would depress managerial efficiency. Some growth by providing room for initiative and exercise of managerial ability would lead to a stimulation of managerial efficiency leading to a lowering of the capital-output ratio and consequently a higher profit rate [Hay and Morris 1984, pp. 287-288]. Faster growth, however, entails significant costs so that profit rates eventually decline with higher growth rate.

7.3 REVIEW OF EMPIRICAL STUDIES

The model G = f(P) has been tested using different specifications by studies such as Parker [1964], Singh and Whittington [1968] and Kumar [1985]. Singh and Whittington, and Parker detected a strong positive relationship between growth and profitability. Kumar [1985] studying the Indian Corporate Sector found that profitability explained only a very small percentage of the growth rate of Indian firms.

The model P = f(g), which is of interest here, was tested by Marris [1966]. Defining growth as the increase in net assets, Marris ran regressions for different time-periods using a sample containing all firms in 131 manufacturing industries. He found a positive relationship between profitability and growth. Radice [1971] and Shepherd [1972, 1975] also included growth as part of their larger models explaining profitability. Radice included average growth of net assets along with variables measuring type of management control, initial size and so on, to explain differences in profitability among 86 firms in the food, electrical engineering and textile industries. He found that growth had a significant positive effect on profitability. Shepherd's model included explanatory variables measuring size and entry barriers besides growth in sales revenue. Growth was found to have a strong positive association with profitability although its quantitative importance was small.

The relationship P = f(g) has not been studied extensively as economists were more interested in the determinants of growth and also possibly because of problems of identification arising from the simultaneity in the relationship between profitability and growth. Apart from the study by Marris, no other study has tested specifically the relationship between profitability and growth. Some studies, as already mentioned, have only included growth as part of larger models explaining profitability. The direction of the relationship as is known is thus still largely based on the theoretical literature.

7.4 THE EMPIRICAL ANALYSIS : SPECIFICATION OF THE MODELS

The analysis, as already mentioned, involves two separate models to study the effects on profitability of growth in the demand and supply sides of the firm. The models are specified as follows.

$$P_1 = a + b_1 GROS + u \qquad (7.1)$$

$$P_2 = a + b_1 GROA + u \qquad (7.2)$$

where P_1 and P_2 are the two profitability measures already defined earlier.

GROS is the simple growth rate of sales revenue measured as $\frac{(\text{Sales Revenue})_n - (\text{Sales Revenue})_{n-1}}{(\text{Sales Revenue})_{n-1}}$, where n stands for year.

GROA is the simple growth rate of total assets measured as $\frac{(\text{Total Assets})_n - (\text{Total Assets})_{n-1}}{(\text{Total Assets})_{n-1}}$, where n again stands for year.

Model 6.1 may be interpreted as studying the effect of growth in demand on profitability while model 6.2 may be interpreted as studying the effect of growth in supply on profitability. Total assets rather than net assets are used to measure growth on the supply side of the firm as they better approximate the company's capacity to produce goods for sale [Parker 1964]. Growth rates are computed between each year in the time-period of the analysis which is 1970-83. In the cross-section analysis both profit and growth rates are measured as averages over the time-period.

The sample for the study consists of thirty-five firms from the original sample. Three firms were dropped as only a relatively short time-series on profitability and growth were available in their cases.

7.5 REGRESSION RESULTS : CROSS-SECTION

Table 7.1 presents the results of the cross-section analysis using the two models described in the last section. The first line in the table shows the results obtained using model 7.1 in which P_1 is the dependent variable and GROS is the measure of growth of the firm. It appears that the model has

not done well. GROS is not significant and so is the computed F-statistic. The $\bar{R}^2$ value is also very low indicating that hardly any variation in P_1 is explained. The redeeming feature of the regression is the sign on GROS which is negative. The negative influence of growth of the demand side on profitability may be the result of the growth rate exceeding low levels as theoretically predicted by Downie [1958] and Marris [1964]. But due to the lack of a strong association it may be said, in general, that profitability is not affected by the growth of the demand side of the firm in the Indian pharmaceutical industry.

The second line in Table 7.1 shows the results obtained using model 7.2 which has P_2 as the dependent variable while growth is measured by GROA. GROA is also found to have a weak negative relationship with P_2. The t-test indicates that GROA is not significant. The goodness-of-fit statistics ($\bar{R}^2$, F) both indicate the poor performance of the regression in explaining variations in P_2. The indication is that the growth rate in supply also does not influence profitability. A few explanations may be in order here, to explain the lack of a significant effect of growth of the firm on its profitability in this industry.

The lack of a significant negative relationship between profitability and the growth of demand may be the result of a fast expanding market for pharmaceutical products. Figures

indicate that the sales value of bulk drugs increased from Rs. 50 crores to Rs. 289 crores, at an annual growth rate of 13.1% between 1972 and 1982. Similarly, the sales value of formulations increased from Rs. 300 crores to Rs. 1,430 crores at an annual growth rate of 16.3% between 1972 and 1982 [see Table 5.1]. Thus in the presence of a dynamic growing market, pharmaceutical firms may have felt no pressure on profit margins in their desire to expand. On the other hand, what may have prevented them from actually improving their profit margins by taking advantage of a quickly growing market are the price and profit controls imposed by the Government. Hence, it may not have been possible to increase profit margins even if the market conditions were favourable.

The slight negative relationship between profitability and growth in supply may be explained by the presence of excess productive capacity. While firms continued to grow[1], the existence of excess capacity, estimated at 58.8% of installed capacity in the public sector and 33.5% in the Indian private sector in 1979 [only the foreign sector produced to capacity], may be held responsible for an increase in the capital-output ratio leading to the slight negative relation between profitability and growth, across firms.

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1. The growth rate in investment in the industry was 3% between 1972 and 1980 for which figures were last available.

7.6 REGRESSION RESULTS : TIME-SERIES

Tables 7.2(a) and 7.2(b) present the results of the time-series analysis. The results of the analysis with model 7.1 are presented in Table 7.2(a). It can be seen that GROS is positive in twenty-four regressions and negative in eleven regressions. GROS is significant in sixteen cases, being positive and significant in fifteen regressions and negative and significant in only one regression. However, the computed F-statistic is significant at different levels in five regressions only. The $\bar{R}^2$'s indicate that the regression has done moderately well explaining 15% to 30% of the variation in P_1 in about a dozen regressions with a high of 65% in the case of Merck Sharpe and Dohme. However, the quantitative importance of GROS is very small with a 10 percentage point increase in company sales adding only 0.3 percentage points to P_1 in the case of Merck Sharpe and Dohme. But in a few other cases where GROS is significant a similar increase in the growth rate would add between 1 percentage point and 1.5 percentage points to P_1. Bearing in mind that apart from one case no other regression has produced a negative and significant coefficient of growth, it implies that growth is not detrimental to the profitability of the firms in this industry.

Table 7.2(b) presents the results of the analysis using model 7.2. GROA is positive in twenty-two regressions and negative in thirteen regressions. GROA is however significant

in only twelve regressions, being positive in sign in eleven of them. The F-statistics obtained for the regressions are significant in six regressions only. As with the case of model 7.1 moderate $\bar{R}^2$'s are obtained in a few regressions explaining between 20% and 40% of the variation in P_2. The highest $\bar{R}^2$ obtained is 0.609 (in the case of Bayer). The quantitative importance of growth seems to be high in the case of a few firms such as Reckitt and Colman, Roussel, Boehringer-Knoll etc., where a 10 percentage point increase in growth rate would add 11, 5 and 3.5 percentage points to P_2. In other cases it does not seem so important. The importance of growth in determining profitability thus seems to vary from firm to firm probably depending on the characteristics of individual firms as Eatwell [1971] had suggested, and possibly also on capacity utilization.

7.7 CONCLUDING REMARKS

The cross-section analysis suggests that profitability, as measured by either of the two measures, is not in general affected by growth in either the demand or supply sides of the firm. The results in the Indian pharmaceutical industry thus differ from the more general results obtained by Radice [1971], Shepherd [1972, 1975] and Marris [1966] all of whom detected a positive relationship between profitability and growth. It was mentioned that the simultaneous expansion of the market

may have actually prevented any adverse effect of growth on profitability. On the other hand, it was felt that the presence of price controls may have prevented the firms from increasing their profit margins. Excess capacity it was felt, may have contributed to the slight negative effect of growth, as measured by the growth in the capacity to supply, on profitability. This is possible if the firms went in for a larger expansion of capacity than warranted by the growth of the market.

The lack of a significant relationship, in general, between profitability and growth points to the possibility that it may vary a great deal between firms, as prompted by Eatwell [1971]. This was indicated by the time-series analysis which showed that the relationship varied between firms. In many cases a positive significant relationship was observed while in other cases no relationship existed between profitability and growth. One can term the situation 'win or no-loss' with growth on both the supply and demand sides not having any detrimental effect on profitability. Likely explanations for these results may lie in the rapid expansion of the drugs and pharmaceuticals market which may have nullified the negative effects of growth on profitability, if any.

Table 7.1

Regression Results (Cross-section): Models 7.1, 7.2

	N	Intercept	GROS	GROA	$\bar{R}^2$	F	DW	3-P Statistic
Model 7.1	35	0.048 (2.232)	-0.124 (-1.044)		0.002	1.091	1.574*	1.291
Model 7.2	35	0.094 (5.470)		-0.021 (-0.137)	-0.029	0.035	1.879*	3.094

t-values are presented within parenthesis.

* - significant at .01 level.

Table 7.2(a)

Regression Results (Time-series): Model 7.1

Company	N	Intercept	GROS	$\bar{R}^2$	F	DW
Duphar Interfran	13	0.035 (8.597)	-0.021 (-0.947)	-0.008	0.398	1.703*
Glaxo Laboratories	13	0.045 (9.966)	0.004 (0.165)	-0.088	0.027	0.983
Boehringer Knoll	13	-0.0002 (-0.017)	0.117 (1.938)**	0.186	3.757	1.648*
Amrutanjan	13	0.020 (6.226)	0.024 (1.818)**	0.161	3.306	1.037*
Rallis	13	0.010 (4.667)	-0.005 (-0.440)	-0.071	0.194	1.711*
Searle	13	0.063 (2.876)	0.155 (1.876)**	0.173	3.520	0.897
Unichem Laboratories	13	0.017 (5.917)	0.022 (1.321)	0.058	1.747	1.419*
Warner Hindusthan	13	0.045 (8.711)	-0.0001 (-0.006)	-0.099	0.000	1.974*
Reckitt and Colman	13	0.038 (8.296)	0.054 (1.801)**	0.157	3.245	1.119*
Standard Pharmaceuticals	12	0.009 (0.625)	0.008 (0.103)	-0.098	0.010	1.507*
Pfizer Laboratories	13	0.056 (10.308)	0.052 (1.154)	0.026	1.332	0.913
Boots	13	0.037 (5.355)	0.027 (0.756)	-0.036	0.572	0.976
Chemo-pharma	12	0.006 (0.332)	-0.039 (-0.793)	-0.034	0.629	1.947*
Alembic	13	0.008 (1.088)	0.118 (1.992)**	0.198	3.970	2.545*

contd ...

Company	N	Intercept	GROS	$\bar{R}^2$	F	DW
Richardson Hindusthan	13	0.027 (5.733)	0.051 (2.114)**	0.224	4.469	1.268*
Cipla	13	-0.007 (-0.595)	0.117 (2.294)**	0.262	5.269**	2.893*
Nila Products	12	-0.003 (-0.322)	0.122 (2.065)**	0.228	4.266	1.432*
Ranbaxy Laboratories	13	0.054 (3.922)	-0.052 (-1.127)	0.022	1.270	0.753
Sandoz Laboratories	13	0.025 (8.161)	0.026 (1.698)***	0.135	2.885	1.675*
German Remedies	13	0.041 (5.775)	-0.010 (-0.295)	-0.082	0.087	1.800*
Bayer	13	0.034 (2.306)	0.145 (2.450)**	0.294	5.003**	0.396
J.L. Morrison	13	0.013 (1.945)	0.030 (1.768)**	0.150	3.128	1.099*
Albert David	13	0.023 (1.699)	-0.036 (-1.077)	0.013	1.161	1.443*
Geoffrey Manners	12	0.016 (3.010)	0.121 (2.849)*	0.392	8.118**	0.803
Infar	12	0.066 (4.820)	-0.025 (-0.479)	-0.075	0.229	0.901
Hoechst	13	0.043 (1.863)	0.074 (0.680)	-0.051	0.462	1.345*
Parke Davies	13	0.048 (4.863)	-0.001 (-0.021)	-0.090	0.001	1.754*
Ciba Geigy	12	0.052 (9.381)	0.020 (2.398)**	0.322	5.754**	1.357*

contd ...

Company	N	Intercept	GROS	$\bar{R}^2$	F	DW
Roche	13	0.037 (3.600)	0.133 (1.895)**	0.177	3.592	1.173*
E. Merck	13	0.022 (3.613)	0.014 (0.813)	-0.028	0.662	1.079*
Roussel	13	0.018 (0.599)	0.150 (1.068)	0.011	1.142	2.492*
Hindusthan Antibiotics	13	-0.158 (-2.663)	0.060 (0.244)	-0.084	0.059	0.952
IDPL	13	-0.064 (-1.163)	-0.119 (-1.477)***	0.089	2.182	0.762
Merck Sharpe Dohme	12	0.007 (1.139)	0.026 (4.455)*	0.653	19.853*	2.611*
Burroughs Wellcome	13	0.049 (6.620)	-0.034 (-1.098)	0.016	1.206	1.270*

t-values are presented within parenthesis

* - significant at .01 level

** - significant at .05 level

*** - significant at .10 level

Table 7.2(b)

Regression Results (Time-series): Model 7.2

Company	N	Intercept	GROA	$\bar{R}^2$	F	DW
Duphar Interfran	13	0.060 (7.874)	-0.044 (-1.000)	0.000	1.000	1.082*
Glaxo Laboratories	13	0.069 (12.952)	-0.013 (-0.400)	-0.075	0.160	1.046*
Boehringer Knoll	13	-0.004 (-0.268)	0.353 (3.004)*	0.400	9.025**	1.284*
Amrutanjan	13	0.034 (5.997)	0.066 (2.420)**	0.288	5.859**	1.797*
Rallis India	13	0.025 (4.586)	-0.013 (-0.418)	-0.073	0.175	1.706*
Searle India	13	0.099 (6.287)	0.080 (1.307)	0.055	1.709	1.720*
Unichem Laboratories	13	0.034 (11.550)	-0.010 (-0.554)	-0.061	0.307	1.369*
Warner Hindusthan	13	0.102 (8.151)	0.012 (0.429)	-0.084	0.184	0.892
Reckitt and Colman	13	0.013 (0.148)	1.096 (1.789)**	0.154	3.200	1.988*
Standard Pharmaceuticals	12	0.050 (1.435)	-0.241 (-1.042)	0.007	1.086	1.551*
Pfizer Laboratories	13	0.093 (14.521)	-0.011 (-0.328)	-0.008	0.108	0.786
Boots	13	0.077 (12.525)	0.002 (0.096)	-0.089	0.009	0.935
Chemopharma	12	-0.005 (-0.259)	0.036 (0.376)	-0.084	0.141	1.454*

contd ...

Company	N	Intercept	GROA	$\bar{R}^2$	F	DW
Alembic	13	0.031 (3.525)	0.003 (0.052)	-0.090	0.002	2.089*
Richardson Hindusthan	13	0.061 (8.159)	-0.011 (-0.192)	-0.037	0.037	1.216*
Cipla	13	0.020 (1.104)	0.054 (0.802)	-0.030	0.644	2.571*
Nila Products	12	-0.008 (-0.630)	0.225 (2.123)**	0.241	4.508	0.864
Ranbaxy Laboratories	13	0.058 (8.109)	-0.012 (-0.932)	-0.010	0.870	0.861
Sandoz Laboratories	13	0.051 (8.185)	-0.011 (-0.400)	-0.075	0.160	1.089*
German Remedies	13	0.063 (11.729)	-0.049 (-2.213)**	0.245	4.898**	1.189*
Bayer	13	0.046 (3.568)	0.139 (4.258)*	0.609	18.133*	1.723*
J.L. Morrison	13	0.035 (2.017)	0.032 (1.561)***	0.115	2.437	2.590*
Albert David	13	0.035 (1.211)	0.034 (0.227)	-0.085	0.051	1.270*
Geoffrey Manners	12	0.077 (11.545)	0.124 (1.921)**	0.196	3.690	1.672*
Infar	12	0.072 (3.397)	-0.049 (-1.125)	0.025	1.265	1.388*
Hoechst	13	0.085 (2.661)	0.094 (1.043)	0.008	1.089	1.031*
Parke Davies	13	0.094 (7.158)	0.110 (1.154)	0.026	1.332	2.047*

contd ...

Company	N	Intercept	GROA	$\bar{R}^2$	F	DW
Ciba Geigy	12	0.077 (4.327)	0.154 (2.069)**	0.247	4.281	1.387*
Roche	13	0.063 (6.394)	0.107 (1.765)**	0.149	3.116	1.322*
E. Merck	13	0.017 (2.345)	0.085 (3.132)*	0.423	9.812*	0.883
Roussel	13	-0.011 (-0.230)	0.515 (2.365)**	0.276	5.593**	2.032*
Hindusthan Antibiotics	13	-0.039 (-1.059)	-0.172 (-1.156)	0.027	1.338	0.993
IDPL	13	-0.016 (-0.365)	-0.074 (-0.749)	-0.041	0.561	0.848
Merck Sharpe Dohme	12	0.024 (1.241)	0.013 (0.470)	-0.084	0.221	2.513*
Burroughs Wellcome	13	0.044 (5.403)	0.015 (0.434)	-0.072	0.188	1.256*

t-values are presented within parenthesis

* - significant at .01 level

** - significant at .05 level

*** - significant at .10 level

CHAPTER 8

PROBABILITY AND DRUG PRICES

3.1 INTRODUCTION

The pharmaceutical industry is one of the most widely regulated Indian industries. It was mentioned in the first chapter that regulations existed in the form of Government controls over the prices of pharmaceutical products and there were ceilings on profitability from pharmaceuticals manufacture. Government policy, as one is aware, is an important determinant of the performance of a firm. Where regulation is stringent it may even be the most important determinant.

The extent of controls on the industry have steadily increased over the years. To quote, "Over the years the net of controls has steadily tightened and today the industry is in great danger of losing its long term viability" [Lall 1982, p. 55]. While price and profit controls formed the cornerstones of Government policy, the exercise of regulation also took other forms. Industrial licensing, controls over monopoly, promotion of the public sector, imposition of restrictions on the operations of multinationals were some of the other forms that regulations took. They are briefly elaborated below.

To begin with, a license was necessary to produce in any industry classified in the first schedule [which includes the pharmaceutical industry] of the Industries (Development and Regulation) Act 1951. Further, the Monopolies and Restrictive Trade Practices Act (MRTP) 1969 provided that firms having one-third of the licensed capacity in any industry and business houses with assets above Rs.20 crores were to be prevented from increasing their dominance and their overall expansion restricted. The Industrial Policy Resolution of 1956 had earlier classified all industries into three broad categories. Industries classified in the first category were reserved exclusively for the public sector. The public sector was also required to take the initiative in the industries belonging to the second category. Only the industries in the third category were left entirely to the private sector. Antibiotics and certain other bulk drugs were classified in the second category where the public sector had to take the lead role. The policy towards production, specifically by the pharmaceutical industry, as enunciated in the New Drug Policy 1978 was to divide drugs into three groups for purposes of reserving items of production by various sectors. The first group of products were to be produced only by the public sector. The second group of products was reserved for production by the Indian sector. Only the third group was open to production by all including the foreign sector. But in

considering industrial licenses for production of this group of products preference had to be shown to Indian Companies over the MRTP units and multinationals. With a view to encouraging the production of bulk drugs by multinationals it was stipulated that all foreign drug companies bring down their foreign equity share holding to 40% of the total if they only processed locally purchased or imported bulk drugs into formulations. Besides, in the future they were to be granted licenses only for the production of high technology bulk drugs and formulations. The New Drug Policy also prescribed norms for the product structure of pharmaceutical firms. The prescribed ratios of the value of bulk drugs to that of formulations were fixed at 1:5 in the case of foreign drug companies and at 1:10 for Indian companies. Apart from the restrictions mentioned above firms were confronted with controls over both prices and profits which are explained in detail below and which form the main focus of the study here.

8.2 PRICE CONTROLS - AN OVERVIEW

Controls on the prices of drugs were imposed for the first time in 1962. The Drug (Display of Prices) Order 1962 required manufacturers, importers, distributors and chemists to publish price lists of all their products. Subsequently, the Drugs (Control of Prices) Order 1963 freezed the sale prices of drugs at the prevailing levels. The objective of these orders

was mainly to control inflationary forces leading to a price rise. In 1966 certain additional provisions were made to the earlier orders making it obligatory on the part of manufacturers to secure the prior approval of the Government before increasing the prices of any formulations. Prices of new drugs also required Government approval. However, prices of generic drugs and new products of original R and D were exempt from price control. Following criticism by the industry that while sale prices were freezed the price control orders had no control over the escalating prices of raw materials, the Tariff Commission was requested to study the cost structure of eighteen specified drugs and thirty-nine formulations based on those drugs. On the basis of the Tariff Commission's report the Government announced the Drug (Prices Control) Order 1970 to replace the earlier orders. Among the various objectives of the order were (a) reduction of the prices of essential drugs and (b) curbing of excessive profits. The order fixed the sale prices of seventeen bulk drugs allowing a profitability of 15% on the capital employed in their production. For formulations the profit ceiling was fixed at 15% of sales turnover. The order allowed for a mark up on production cost of 75% for essential formulations and 150% on others to meet post-manufacturing expenses such as selling and distribution expenses, freight and trade commission. Profits were also to be recovered from the mark-ups but were

subject to the ceilings mentioned earlier. The manufacturers were asked to revise the prices of various products along these guidelines. When it was found that some prices would increase as a consequence, the Government after freezing the prices at levels before the commencement of the order, examined the cost structure of 11,732 products. Subsequently, the prices of 44.96% of the formulations were reduced, 36.15% kept at the earlier levels and price rises granted in respect of only 11.45% of the formulations [Narayana 1984].

In 1979, the Government promulgated the Drug (Prices Control) Order 1979 to replace the DPCO 1970. Under this order, the Government classified all formulations into four categories and the mark-ups on ex-factory costs were fixed at forty percent, fifty-five percent, hundred percent and free mark up for categories I, II, III and IV formulations subject to an overall ceiling on pre-tax profitability which varied between eight to thirteen percent on the sales turnover from formulations. The profitability ceilings were fixed taking into consideration various criteria such as size of the unit, basic drugs manufacturing activity, R and D activity and so on. The costs to be met from the mark-ups were identified as expenses on promotion, distribution, freight and trade commission. The balance after meeting these expenses were the profits. The prices of bulk drugs were estimated on the basis of the costs of an efficient producer allowing a post-tax returns on net-worth of fourteen percent for bulk drugs used in the production

of categories I and II formulations and twelve percent in the case of other bulk drugs. The Government was also empowered to fix leader prices for different formulations in categories I, II and III based on the costs of an efficient manufacturer. These prices were the highest that any producer could charge.

The price controls have been heavily criticized both by the industry and others who have blamed these controls as being responsible for the poor performance of the industry. As mentioned in the introduction various studies have shown that the profitability of pharmaceutical firms have been declining steadily. A Reserve Bank of India study had shown the ratio of profit before tax to sales expressed in percentage terms to decline from 16.4% in 1970-71 to 8.8% in 1980-81. Narayana [1984] also showed that the profit before tax as a percentage of sales turnover on formulation activity declined from 8.80% in 1978 to 4.25% in 1980. The major complaint of the industry has been that while fixing prices the Government was oblivious to the cost of raw materials. Secondly, the time-lag in fixing or revising controlled prices meant that cost escalation in the ensuing period squeezed profitability. Narayana [1984] also showed that the mark-ups allowed on certain categories of formulations were lower than the break-even levels. The industry claimed that its very viability was under threat from price controls. An article in the 'CAPITAL' noted, "The Drugs and Pharmaceutical industry argues that the costs of raw materials

are constantly increasing, the Government's New Drug Policy and the Drugs (Prices Control) Order is making the production of many vital drugs uneconomic and if the profitability of the Drug Industry continues to be eroded at this rate the shortage may accentuate and the Industry may become sick" [Capital 1984].

With price controls having acquired a major degree of importance in determining the performance of pharmaceutical firms, if one were to go by industry arguments, there has been a dearth of studies relating drug pricing to performance which calls for an indepth examination of this factor in determining the performance of firms in this industry. The only exception has been Narayana [1984] who computed the break-even mark-ups for a sample of twenty-three drug manufacturing units to see whether the units were able to recover all their post-manufacturing expenses at the Government prescribed mark-up rates. The break-even mark-up was found to be on an average around 63% of manufacturing expenses. It was also found that the break-even mark-up for units producing only category III and IV formulations was marginally higher than the average break-even mark-up. When the contribution of categories I and II formulations was around 30% of total sales the break-even mark-up was found to be equal to the average break-even mark-up. The average break-even mark-up was found to be higher than the mark-ups allotted for

categories I and II formulations by the Drug (Prices Control) Order 1979. The study also made a comparison between the growth rates of ex-factory cost, post-manufacturing expenses and the sales value of formulations. Both the cost components were found to grow faster than the sales value. What the study did not do is to make a direct comparison between the sale prices of drugs and formulations and profitability in view of the fact that the Government has taken it upon itself to fix 'leader' prices based on the costs of an efficient manufacturer of categories I, II and III formulation and of bulk drugs. This is important because a major complaint of the industry has been that price revisions granted by the Government were not commensurate with overall cost increases and as a consequence profitability was being affected. This is the focus of our analysis in this chapter. Specifically, we intend to establish the quantitative relationships between profitability and changes in the output price index as well as cost index of the industry. This would be a simple regression analysis, quite adequate to reflect the impact of price regulation on profitability of the firms in the industry. In the next section we present the specification of the models for testing, followed by the sections dealing with the empirical results and concluding remarks.

8.3 THE EMPIRICAL ANALYSIS : SPECIFICATION OF THE MODELS

Three separate models are used to study the influence of price controls in determining profitability. They are described below.

$$P_1 = a + b_1 WDPI + u \qquad (8.1)$$

$$P_1 = a + b_1 (WDPI/ACPI) + u \qquad (8.2)$$

$$P_2 = a + b_1 (WDPI/ACPI) + u \qquad (8.3)$$

where P_1 and P_2 are the usual measures of profitability, WDPI is the wholesale price index of drugs and pharmaceuticals and ACPI is the All Commodities Price Index.

Model 8.1 is formulated to study the impact of the movements in the prices of drugs and pharmaceuticals on profitability, more specifically the profit margins. It would show the effect of the revision of prices undertaken periodically by the Government on the profit margins of pharmaceutical firms. If the industry's complaints that the price revisions granted by the Government were not adequate to cover increases in production cost are correct, then apriori, a negative sign can be expected on the coefficient of the explanatory variable. The effect would be greater in the case of firms having a larger proportion of category I and II products in their product profiles whose prices were tightly controlled than in the case of firms producing more of categories III and IV

Model 8.3 involves the regression of P_2, the return on assets, on the ratio of the wholesale drug price index to the all commodity price index. This model is being used to test whether inadequate price revisions had the same effect if performance were measured by an alternate measure of profitability. Faced with controls on prices and declining profit margins the firms may have altered their strategy to one of sales maximization to maintain the size of their profits. Consequently P_2 may remain unaffected or may even increase if firms were successful in pushing their sales enough to increase the size of their profits, inspite of a decrease in their profit margins.

The test of these models was possible for obvious reasons, only with time-series data. The data on price indices for the period of the study was obtained from various annual bulletins of the Reserve Bank of India. The base year for the computation of the price indices is 1970-71. The sample consists of all the thirty-eight firms in the basic sample.

8.4 REGRESSION RESULTS: TIME SERIES

The results of the analysis using model 8.1 are presented in Table 8.1. P_1 is found to be negatively related with WDPI the wholesale price index of drugs and pharmaceuticals in twenty-five cases and the regression coefficient is found to be significant at different levels in seventeen of them. P_1 is

positively related with WDPI in thirteen regressions and the regression coefficient is significant in seven of them. The computed F-statistics are found to be significant at different levels in fifteen regressions. Further evidence that the regression has done well in a number of cases can be had from the $\bar{R}^2$ values. The highest obtained value of $\bar{R}^2$ is 0.868, in the case of Geoffrey Manners. The $\bar{R}^2$'s are also high in the cases of Warner Hindusthan, Nila Products and Ranbaxy Laboratories. Overall, the $\bar{R}^2$'s indicate that more than 50% of the variation in P_1 is explained in eight cases. In a further eight cases 25% to 50% of the variation is explained.

An examination of the data on the wholesale price index of drugs and formulations shows that it has risen from a base of 100 in 1970-71 to 189.2 in 1983-84. The negative and significant relationship of P_1 with WDPI obtained in many cases indicates that profitability declined despite an increase in sale prices as revealed by the increase in the price index. This seems to provide evidence that the price revisions granted by the Government were not adequate in many cases. The insignificant relationship of P_1 with WDPI obtained in other cases seems to indicate that the price revisions granted by the Government may have just compensated the increase in the cost of production leaving profitability unaffected. In a few cases however the price increases benefitted the firms as indicated by the positive and significant relationship P_1 had with WDPI.

A closer look at some of the more diversified firms shows that not all of them have been successful in maintaining their overall profitability. Diversified firms like Sandoz [Berry's index 0.64] and Bayer [0.61] reveal negative coefficients indicating their inability to recoup profitability suffering from low pharmaceutical prices. On the other hand there are firms such as J.L. Morrison [0.73], Cadilla [0.64] and Ciba Geigy [0.59] which improved profitability as indicated by the positive significant coefficient and firms such as Rallis [0.78] and Reckitt and Colman [0.72] whose profitability most likely was unaffected as indicated by the coefficient remaining insignificant.

Table 8.2 presents the results of the analysis using model 8.2. P_1 is found to be negatively related with the explanatory variable WDPI/ACPI in eleven cases but the regression coefficient is significant at different levels in only four of them. P_1 is positively related with WDPI/ACPI in twenty-seven cases and the regression coefficient is significant in twenty of them at different levels. The model seems also to have done well in terms of explanatory power. The computed F-statistic is significant at different levels in nineteen regressions. The $\bar{R}^2$'s indicate that the regression explains more than 50% variation in P_1 in ten cases and between 25% to 50% of the variation in P_1 in another nine cases. An examination of the data on the independent variable WDPI/ACPI

shows that the ratio declined from 1 in 1970-71 to 0.59 in 1983-84. This indicates that the increase in input costs were disproportionate to the increase in the prices of pharmaceutical products. In the many cases where P_1 has a positive and significant relationship with WDPI/ACPI the indication therefore is that profitability P_1 had decreased corresponding to the fall in WDPI/ACPI. A comparison with the results obtained with model 8.1 which were presented in Table 8.1 indicates that in every case where model 8.1 had shown the relationship between P_1 and WDPI to be negative and significant. model 8.2 shows that the relationship between P_1 and WDPI/ACPI is positive and significant which seems to substantiate arguments of price increases being inadequate to cover increases in cost. However, there are a few firms for whom the opposite is true. Inspite of a fall in the ratio of the price indices profitability increased thus resulting in P_1 having a negative and significant relationship with WDPI/ACPI. This is as it should be in these cases as model 8.1 had shown the existence of a positive relationship between P_1 and WDPI. It thus appears that the price revisions granted by the Government may have more than adequately compensated increase in input costs in these cases. However, the price indices being general, this has not been adequately captured by the ratio of the price indices in these individual cases. The firms in question such as Ranbaxy, J.L. Morrison and Ciba Geigy were also well diversified. It is, therefore, also possible that the increase in

profitability was a result of improved performance in their other areas of manufacture.

Table 8.3 contains the results of the analysis using model 8.3. P_2 is seen to have a negative relationship with WDPI/ACPI in twenty cases. The regression coefficient is significant at different levels in fifteen of them. P_2 is positively related with WDPI/ACPI in eighteen cases but the coefficient is significant at different levels in only nine of them. In terms of explanatory power this model does not seem to have performed as well as model 8.2. The computed F-statistic is significant in only thirteen regressions. The $\bar{R}^2$'s indicate that more than 50% of the variation in the dependent variable P_2 is explained in only one case by the model although between 25% and 50% variation is explained in a dozen cases.

A comparison of these results with the results presented earlier in Table 8.2 shows that in some cases for example, Duphar Interfran, Boehringer Knoll, Amrutanjan and Warner-Hindusthan, the coefficient of WDPI/ACPI is insignificant when model 8.3 is used in the analysis whereas it was positive and significant when model 8.2 was used. Further, in two cases, viz., Unichem and Alembic the coefficient of WDPI/ACPI obtained from model 8.3 are negative and significant. Moreover, the use of model 8.3 shows that the coefficient of WDPI/ACPI is negative and significant in almost every case where it was so when model 8.2 was used, the only exception being IDPL where WDPI/ACPI

is positive and significant instead. The comparison also shows that there are cases such as Glaxo, Rallis and Reckitt and Colman where the coefficient of WDPI/ACPI was insignificant when model 8.2 was used and negative and significant when model 8.3 is used instead. The picture that emerges is that while cost increases may have eaten into the profit margins as measured by the profitability on sales P_1, the profitability on assets P_2 was not seriously eroded. The firms involved may have compensated the decline in their profit margins by pushing sales to maintain or in some cases even increase the size of their profits which resulted in a stable or an increasing P_2, the return on capital employed, despite increases in manufacturing cost and low prices. But there are also cases such as Standard Pharmaceuticals, Pfizer and Bayer where the analysis with models 8.2 and 8.3 shows that both measures of profitability had a positive significant relationship with WDPI/ACPI proving that inadequate price increases had been detrimental to profitability in their cases. It is possible that these firms did not follow a policy of sales maximization or were not successful enough in pushing their sales.

8.5 CONCLUDING REMARKS

The analysis found that Government price controls played an important role in determining the profitability of firms in the pharmaceutical industry. Evidence showed that even though

there was a general increase in the wholesale price index of drugs and pharmaceuticals, meaning an increase in selling prices, in many cases the profitability on sales turnover had declined. Subsequently it was seen that increases in the cost of inputs had not been fully compensated by the increase in selling prices with the result that profit margins were eaten into. While this was true in many cases it was not the general picture. There were cases where no significant influence of the price variable on profitability could be detected probably indicating that increase in selling prices may have fully compensated increases in production cost resulting in unchanged profitability. In a few cases the coefficient of the price variable was positive and significant suggesting that profit margins may have improved following price revisions. Alternatively, strategic responses to price controls, such as diversification may have had helped preserve overall profitability.

While the pressure on profit margins may have resulted in lower profitability on sales this was not always the case with profitability as measured by the return on capital employed. It seems that price controls may have compelled firms to adopt alternate strategies such as sales maximization which helped to preserve and in many cases to increase the size of their profits and this in turn led to stable or higher returns on assets. That such a strategy may have paid off is evident from the negative relationships obtained when fitting model 8.3.

Table 8.1

Regression Results : Model 8.1

Company	N	Intercept	WDPI	$\bar{R}^2$	F	DW
Duphar Interfran	14	0.051 (2.868)	-0.125 (-0.937)	-0.009	0.878	1.012
Glaxo Laboratories	14	0.058 (5.075)	-0.086 (-0.995)	-0.001	0.990	0.979
Boehringer Knoll	14	0.127 (3.128)	-0.838 (-2.723)*	0.330	7.419**	2.498*
Amrutanjan	14	0.037 (2.958)	-0.096 (-1.019)	0.003	1.040	1.599*
Rallis	14	0.013 (1.722)	-0.026 (-0.453)	-0.065	0.205	1.772*
Searle	14	0.185 (3.343)	-0.678 (-1.623)***	0.111	2.636	1.538*
Unichem Laboratories	14	0.048 (6.400)	-0.203 (-3.575)*	0.475	12.780*	1.322*
Warner Hindusthan	14	0.107 (10.831)	-0.404 (-5.404)*	0.684	29.204*	1.380*
Reckitt and Colman	14	0.037 (2.527)	0.065 (0.577)	-0.054	0.333	1.046
Standard Pharmaceuticals	13	0.107 (2.339)	-0.732 (-2.033)**	0.207	4.135	1.734*
Pfizer	14	0.114 (8.866)	-0.389 (-4.016)*	0.537	16.129*	1.080*
Boots	14	0.063 (6.978)	-0.160 (-2.341)**	0.256	5.483**	1.092*
Chemopharma	13	-0.003 (-0.046)	0.031 (0.058)	-0.090	0.003	1.632*
Alembic	14	0.021 (1.000)	0.017 (0.104)	-0.082	0.010	1.687*

contd ...

Company	N	Intercept	WDPI	$\bar{R}^2$	F	DW
Cadilla Laboratories	11	-1.160 (-2.343)	7.539 (2.136)**	0.262	4.563	1.947*
Richardson Hindusthan	14	0.017 (1.005)	0.111 (0.901)	-0.015	0.813	2.229*
Cipla	14	-0.020 (-0.715)	0.302 (1.426)***	0.073	2.035	2.568*
Nila Products	13	0.160 (4.980)	-1.235 (-5.061)*	0.672	25.623*	2.076*
Ranbaxy Laboratories	14	-0.013 (-1.536)	0.397 (5.935)*	0.724	35.228*	2.180*
Sandoz Laboratories	14	0.052 (8.072)	-0.169 (-3.439)*	0.454	11.830*	1.561*
German Remedies	14	0.045 (4.976)	-0.038 (-0.554)	-0.056	0.307	1.656*
Bayer	14	0.225 (6.248)	-1.200 (-4.418)*	0.587	19.579*	0.811
J.L.Morrison	14	-0.054 (-1.859)	0.343 (2.476)**	0.283	6.134**	1.370*
Albert David	14	-0.006 (-0.109)	0.168 (0.365)	-0.071	0.133	1.603*
Geoffrey Manners	13	0.081 (14.556)	-0.396 (-8.975)*	0.868	80.568*	1.642*
Cynamid	12	0.218 (5.129)	-1.063 (-3.430)*	0.494	11.766*	0.945
Infar	13	0.009 (0.238)	0.414 (1.434)***	0.081	2.057	0.892
Hoechst	14	0.157 (3.812)	-0.693 (-1.975)**	0.182	3.902	0.777
Parke Davies	14	0.157 (3.806)	-0.783 (-2.516)**	0.290	6.332**	2.077

contd ...

Company	N	Intercept	WDPI	$\bar{R}^2$	F	DW
Ciba Geigy	13	0.026 (1.970)	0.215 (2.007)**	0.201	4.031	1.169*
Roche	14	0.143 (6.417)	-0.666 (-3.963)*	0.530	15.709*	2.242*
E. Merck	14	-0.006 (-0.318)	0.244 (1.655)***	0.118	2.740	1.278*
Roussel	14	0.077 (1.393)	-0.222 (-0.532)	-0.058	0.283	2.359*
Hindusthan Antibiotics	14	0.122 (0.560)	-1.966 (-1.193)	0.031	1.423	1.039
IDPL	14	0.234 (1.539)	(-2.152) (-1.955)**	0.190	3.823	0.751
Merck Sharpe Dohme	13	0.136 (6.210)	-0.824 (-4.787)*	0.646	22.915*	0.906
Burroughs Wellcome	14	0.039 (2.255)	0.020 (0.156)	-0.081	0.024	1.097*
Curewel	10	0.078 (0.517)	-0.082 (-0.072)	-0.124	0.005	1.503*

t-values are presented within parenthesis

* - significant at the .01 level

** - significant at the .05 level

*** - significant at the .10 level

Table 8.2

Regression Results : Model 8.2

Company	N	Intercept	(WDPI/ ACPI)	$\bar{R}^2$	F	DW
Duphar Interfran	14	0.001 (0.080)	0.047 (2.130)**	0.213	4.538	1.213*
Glaxo Laboratories	14	0.032 (2.863)	0.020 (1.289)	0.048	1.662	1.077*
Boehringer Knoll	14	-0.059 (-1.238)	0.109 (1.664)***	0.119	2.771	1.996*
Amrutanjan	14	-0.004 (-0.449)	0.041 (2.911)*	0.365	8.478**	1.909*
Ballis	14	0.016 (2.153)	-0.009 (-0.887)	-0.016	0.787	1.820*
Searle	14	0.030 (0.511)	0.094 (1.152)	0.024	1.328	1.413*
Unichem Laboratories	14	-0.010 (-1.858)	0.045 (5.836)*	0.719	34.417*	1.869*
Warner Hindusthan	14	-0.001 (-0.152)	0.079 (6.570)*	0.764	43.177*	1.788*
Reckitt and Colman	14	0.054 (3.577)	-0.011 (-0.555)	-0.056	0.308	1.017
Standard Pharmaceuticals	13	-0.099 (-3.241)	0.159 (3.820)*	0.531	14.595*	2.511*
Pfizer	14	0.008 (0.710)	0.077 (4.748)*	0.623	22.547*	1.304*
Boots	14	0.013 (1.886)	0.040 (4.078)*	0.545	16.632*	1.116*
Chemopharma	13	-0.013 (-0.189)	0.020 (0.204)	-0.086	0.041	1.622*

contd ...

Company	N	Intercept	(WDPI/ ACPI)	$\bar{R}^2$	F	DW
Alembic	14	-0.005 (-0.283)	0.042 (1.490)***	0.085	2.221	1.789*
Cadilla Laboratories	11	0.837 (1.089)	-1.478 (-1.254)	0.054	1.574	1.354*
Richardson Hindusthan	14	-0.025 (-1.674)	0.091 (4.355)*	0.580	18.971*	1.154*
Cipla	14	0.053 (1.833)	-0.048 (-1.202)	0.033	1.444	2.442*
Nila Products	13	-0.072 (-1.294)	0.103 (1.340)***	0.062	1.795	1.157*
Ranbaxy Laboratories	14	0.078 (5.862)	-0.057 (-3.086)*	0.396	9.528*	1.435*
Sandoz Laboratories	14	0.007 (1.214)	0.032 (3.536)*	0.469	12.505*	1.519*
German Remedies	14	0.031 (3.477)	0.012 (1.023)	0.003	1.047	1.725*
Bayer	14	-0.118 (-5.340)	0.264 (8.633)*	0.849	74.536*	1.517*
J.L.Morrison	14	0.105 (4.136)	-0.125 (-3.557)*	0.472	12.657*	1.687*
Albert David	14	0.068 (1.136)	-0.075 (-0.902)	-0.014	0.813	1.704*
Geoffrey Manners	13	-0.004 (-0.554)	0.051 (4.488)*	0.614	20.147*	1.050*
Cynamid	12	- 0.119 (-2.527)	0.292 (4.156)*	0.596	17.276*	1.079*
Infar	13	0.052 (1.115)	0.016 (0.247)	-0.084	0.061	0.847
Hoechst	14	-0.039 (-0.889)	0.150 (2.446)**	0.277	5.987**	0.957

contd ...

Company	N	Intercept	(WDPI/ ACPI)	$\bar{R}^2$	F	DW
Parke Davies	14	-0.060 (-1.529)	0.163 (2.996)*	0.380	8.977*	2.276*
Ciba Geigy	13	0.072 (5.801)	-0.026 (-1.534)***	0.101	2.354	1.166*
Roche	14	-0.022 (-0.902)	0.112 (3.191)*	0.413	10.183*	1.825*
E. Merck	14	0.038 (1.749)	-0.017 (-0.590)	-0.052	0.348	1.143*
Roussel	14	0.105 (1.925)	-0.080 (-1.061)	0.009	1.126	2.331*
Hindusthan Antibiotics	14	-0.625 (-3.360)	0.693 (2.697)*	0.325	7.275**	1.440*
IDPL	14	1.214 (2.235)	-2.037 (-2.713)*	0.328	7.363**	0.948
Merck Sharpe Dohme	13	-0.061 (-3.690)	0.131 (5.775)*	0.729	33.362*	1.396*
Burroughs Wellcome	14	0.028 (1.611)	0.020 (0.835)	-0.023	0.697	1.033*
Curewel	10	-0.099 (-0.731)	0.246 (1.248)	0.058	1.558	1.789*

t-values are presented within parenthesis

* - significant at the .01 level

** - significant at the .05 level

*** - significant at the .10 level

Table 8.3

Regression Results : Model 8.3

Company	N	Intercept	(WDPI/ ACPI)	$\bar{R}^2$	F	DW
Duphar Interfran	14	0.089 (2.746)	0.009 (0.199)	-0.079	0.039	1.750*
Glaxo Laboratories	14	0.110 (6.283)	-0.033 (-1.365)***	0.062	1.864	1.096*
Boehringer Knoll	14	0.072 (1.266)	0.017 (0.226)	-0.078	0.051	2.366*
Amrutanjan	14	0.093 (3.300)	-0.025 (-0.639)	-0.047	0.409	1.457*
Rallis	14	0.133 (6.304)	-0.068 (-2.344)**	0.256	5.495**	3.423*
Searle	14	0.200 (3.587)	-0.049 (-0.633)	-0.048	0.401	1.940*
Unichem Laboratories	14	0.119 (6.579)	-0.044 (-1.782)**	0.143	3.178	1.185*
Warner Hindusthan	14	0.120 (7.586)	0.001 (0.079)	-0.082	0.006	1.182*
Reckitt and Colman	14	0.625 (2.243)	-0.670 (-1.739)***	0.134	3.026	2.155*
Standard Pharmaceuticals	13	-0.122 (-2.260)	0.237 (3.197)*	0.434	10.224*	1.746*
Pfizer	14	0.035 (1.640)	0.084 (2.867)*	0.357	8.225**	1.172*
Boots	14	0.101 (6.205)	0.008 (0.375)	-0.070	0.140	1.332*
Chemopharma	13	0.094 (1.413)	-0.036 (-0.404)	-0.074	0.163	1.987*
Alembic	14	0.152 (3.843)	-0.084 (-1.550)***	0.097	2.403	1.540*

contd ...

Company	N	Intercept	(WDPI/ ACPI)	$\bar{R}^2$	F	DW
Cadilla Laboratories	11	0.925 (3.141)	-1.234 (-2.732)*	0.392	7.466**	0.838
Richardson Hindusthan	14	0.080 (1.599)	0.031 (0.412)	-0.074	0.170	0.965
Cipla	14	0.133 (2.730)	-0.089 (-1.322)	0.054	1.748	2.384*
Nila Products	13	-0.002 (-0.039)	0.085 (0.981)	-0.003	0.962	1.208*
Ranbaxy Laboratories	14	0.180 (5.617)	-0.104 (-2.364)**	0.261	5.592**	1.571*
Sandoz Laboratories	14	0.098 (3.997)	-0.004 (-0.145)	-0.081	0.021	1.368*
German Remedies	14	0.150 (6.288)	-0.045 (-1.382)***	0.065	1.911	0.946
Bayer	14	0.022 (0.996)	0.150 (4.780)*	0.627	22.854*	2.440*
J.L.Morrison	14	0.209 (5.456)	-0.192 (-3.621)*	0.482	13.113*	1.724*
Albert David	14	0.230 (2.041)	-0.242 (-1.556)***	0.098	2.422	1.134*
Geoffrey Manners	13	0.038 (2.201)	0.072 (2.994)*	0.399	8.968**	1.800*
Cynamid	12	0.001 (0.023)	0.153 (1.231)	0.044	1.516	1.154*
Infar	13	0.205 (3.286)	-0.158 (-1.623)***	0.129	2.635	1.801*
Hoechst	14	0.092 (1.613)	0.063 (0.798)	-0.028	0.637	0.842
Parke Davies	14	-0.012 (-0.171)	0.192 (1.931)**	0.173	3.731	2.376*

contd ...

Company	N	Intercept	(WDPI/ ACPI)	$\bar{R}^2$	F	DW
Ciba Geigy	13	0.180 (5.892)	-0.097 (-2.318)**	0.267	5.373**	1.184*
Roche	14	0.046 (1.210)	0.060 (1.150)	0.024	1.323	1.857*
E.Merck	14	0.161 (5.958)	-0.093 (-2.512)**	0.290	6.312**	1.313*
Roussel	14	0.279 (3.196)	-0.206 (-1.709)***	0.128	2.922	2.485*
Hindusthan Antibiotics	14	-0.191 (-1.871)	0.222 (1.572)***	0.101	2.471	0.993
IDPL	14	-0.104 (-1.626)	0.225 (2.259)**	0.254	5.103**	1.182*
Merck Sharpe Dohme	13	0.025 (0.861)	0.109 (2.699)*	0.343	7.288**	1.546*
Burroughs Wellcome	14	0.111 (5.813)	-0.063 (-2.416)**	0.271	5.838**	1.531*
Curewel	10	-0.031 (-0.416)	0.175 (1.583)***	0.143	2.508	2.148*

t-values are presented within parenthesis.

* - significant at the .01 level

** - significant at the .05 level

*** - significant at the .10 level

CHAPTER 9

THE FULL MODEL

9.1 MODEL SPECIFICATION

The analysis carried out so far by introducing the different variables under consideration in separate two variable regression models, with the aim of studying their importance in determining profitability, can at best be termed a partial analysis. The analysis while helping us in understanding the individual influences of the different structural variables is not sufficient to get a complete picture of their importance when they are present all at once. While some variables may become stronger some may lose their importance in the presence of other variables. It is, therefore, necessary to introduce all the variables together in a full model to find their relative importance in determining firm-level profitability. With this objective in mind, three separate linear models are framed which include all the variables considered previously. They are

$$P_1 = a + b_1 SIZ_1 + b_2 DIV + b_3 VI + b_4 ADVINT + b_5 GROS \qquad (9.1)$$

$$P_2 = a + b_1 SIZ_2 + b_2 DIV + b_3 VI + b_4 ADVINT + b_5 GROA \qquad (9.2)$$

$$P_2 = a + b_1 SIZ_2 + b_2 DIV + b_3 VI + b_4 ADVINT + b_5 GROS \qquad (9.3)$$

To recapitulate,

P_1 is the ratio of net profits to total sales revenue.

P_2 is the ratio of operating profits to total assets.

SIZ_1 is firm size as measured by total sales revenue.

SIZ_2 is firm size as measured by total assets.

DIV is the extent of diversification measured by the Berry's index.

VI is the extent of vertical integration measured by the ratio of value-added to total sales revenue.

GROS is the simple growth rate of total sales revenue from the beginning of the time-period.

GROA is the simple growth rate of total assets from the beginning of the time-period.

Size is included only in the linear term as the earlier analysis did not suggest any nonlinearity in the size term.

The models are tested with cross-section data covering different years in the time-period 1970-1983. However, due to the uneven nature of reporting, as mentioned in the second chapter, the greatest concentration of firms reporting data on all the variables is available only between the years 1974-82. As a consequence, the number of observations available for testing the models vary in the beginning and at the end of the time-period. Time-series data could not be used on account of the small number of degrees of freedom available when all the variables are considered together.

Secondly, high simple correlation coefficients between some of the explanatory variables obtained in time-series testing suggested the presence of multicollinearity. The sample for the study consists of thirty-one firms chosen from the original thirty-eight. Seven firms are dropped as data on all the variables included in the model is not available.

9.2 REGRESSION RESULTS

The simple correlation coefficients between the different variables occurring in model 9.1 are presented year-wise in Tables 9.1 to 9.5. The first line in these tables shows that the correlation between profitability measured by P_1 and size represented by SIZ_1 is small. The correlation between profitability and diversification is only slightly stronger. While the correlation between profitability and size is weakly positive the correlation between profitability and diversification is negative. The correlation between profitability and vertical integration and between profitability and growth is positive with the relationship between profitability and vertical integration being the stronger of the two. In Table 9.5 the correlation between profitability and vertical integration is a high 0.615. In the same table the correlation between profitability and advertising intensity is highest at 0.378. Otherwise, the correlation between profitability and advertising intensity tended to be weak and somewhat confusing. being weakly negative in two Tables [9.2 and 9.3].

The relationship between size and diversification and between size and vertical integration is quite strong but never greater than 0.50. The correlation between size and diversification is positive giving support to the contention that the larger firms are the more diversified. On the other hand, the correlation between size and vertical integration is negative showing that the larger firms are not necessarily the more integrated. Another possibility is that the negative correlation is caused by the presence of SIZ_1, the total sales revenue, in the denominator of the measure of vertical integration. The correlation between size and growth of sales revenue is negative but is very weak showing that absolutely no relationship exists between the growth of a firm and its size. Size and advertising intensity are also negatively related showing that larger firms were necessarily not the most advertising intensive. This is possible if the large firms are old, well established in the market and possess a good image. They may also possess first-mover advantages, being the earliest entrants into the market. Consequently they may only have to spend less on advertising as a percentage of sales turnover when compared with other firms. Diversification and vertical integration, diversification and advertising intensity and, diversification and growth of sales revenue are all negatively correlated. The negative correlation between diversification and vertical integration seems to

imply that the more diversified firms were frequently less integrated. The relationship between diversification and advertising intensity seems to reflect the relationship between size and advertising intensity as the larger firms appear to be the more diversified. It also seems that the greater the diversification the lower are the growth rates of sales revenue. Advertising intensity and growth rate of sales revenue have practically no relationship with each other.

Table 9.6 presents the results obtained by using model 9.1 to fit the data. In estimating the equation, the tests for heteroscedasticity, spatial autocorrelation and multicollinearity were carried out along the lines mentioned in the second chapter. While the presence of multicollinearity could not be detected, heteroscedasticity is found to be present in one regression as the Breush-Pagan test reveals. In general, where heteroscedasticity is shown to be present the variables are weighted by the square root of the size variable appearing in the regression model. The equation is then re-estimated. The argument in using size as the weighting variable, as already stated before, is that large firms are expected to experience smaller variance in their profitability on account of their greater diversification or other pecuniary advantages. Therefore, the sum of squares of the residuals would be proportional to the inverse of size and the appropriate weight would be the one suggested above. As a result

of the weighting the standard errors of the estimates are seen to have decreased. The presence of spatial autocorrelation is not detected. However, the Durbin-Watson statistic is seen to have fallen in the inconclusive region in one case [1982].

It can be seen that the coefficients of size, vertical integration, advertising intensity and growth are positive in sign. The coefficient of the diversification variable DIV is generally negative. The coefficient of the size variable SIZ_1, is significant in three regressions, once at the .05 level and twice at the .10 level. The coefficient of the vertical integration variable VI is significant in all the regressions mostly at the .01 or .05 levels whereas the coefficient of the growth variable GROS is significant in two regressions at the .05 level. Quantitatively speaking, vertical integration appears to be the strongest determinant of profitability. An increase of 10 percentage points in VI increases profitability from a maximum of 3.8 percentage points [1975] to a minimum of 1.6 percentage points [1979]. The size effect is found to be weak. An increase in size by Rs.100 million would increase profitability by a maximum of 1.3 percentage points [1975]. In other regressionssize is even less important with a difference in size of Rs.500 million leading to a difference in profitability ranging between 1 percentage point to 1.35 percentage points. GROS also appears quantitatively unimportant with the smallest increase in the growth

rate required to increase profitability by 1 percentage point being 30 percentage points. Inspite of a few variables being found to be significant determinants, the model as a whole has not performed too well. The F-statistic is found to be significant in only one regression. Barring one regression [1982], the $\bar{R}^2$'s are also found to be low. On the whole the explanatory power of the model is not found to be very satisfactory.

Tables 9.7 to 9.11 present the simple correlation coefficients among the variables featuring in model 9.2. As in the previous case, it can be seen that the correlation between profitability P_2 and diversification is weak and negative in sign. The correlation between P_2 and VI and between P_2 and GROA is positive in sign. The correlation between P_2 and VI is found to be strongest in Table 9.11 at 0.523 as is the correlation between P_2 and GROA at 0.394. The correlation between P_2 and SIZ_2 is weak and changes sign as does the correlation between P_2 and ADVINT. The correlation between SIZ_2 and DIV is moderately high, the highest correlation coefficient obtained being 0.50 in Table 9.7. This confirms the hypothesis that the larger firms in the sample tend to be the more diversified. SIZ_2 and VI are negatively correlated and the correlation coefficient is around 0.30. This conforms with the correlations obtained in the previous case even though size is now measured by total assets. It thus seems even more that while the larger firms in the sample are the more diversified they are not

necessarily the more integrated. SIZ_2 and ADVINT are negatively related as before. The correlation between DIV and GROA is negative suggesting that diversified firms may have experienced slower growth rates in assets. Being in most cases relatedly diversified, it is probable that the firms have added to their product range by utilizing the excess capacities in existing investments and may not have invested in new facilities to produce new products. Likewise, there is practically no correlation between VI and GROA and between SIZ_2 and GROA suggesting that extensive vertical integration may not have taken place and secondly, that large size does not seem to have been important for growth. Finally, little correlation is found to exist between ADVINT and GROA.

Results obtained by using model 9.2 to fit the data are presented in Table 9.12. Tests showed that no multicollinearity was indicated. The Durbin-Watson statistic, however, falls in the inconclusive region in a couple of regressions. Heteroscedasticity appears in one regression which is re-estimated after weighting all the variables present in the regression by the square root of SIZ_2. An inspection shows that the regressions have not done well except in a single instance where the $\bar{R}^2$ obtained is reasonable and the F-statistic is significant at the .05 level. The results provide only slight evidence that vertical integration and growth are important in determining profitability. These two variables are

found to be positive and significant in only two regressions at the .01 and .05 levels. DIV is negative in sign and insignificant. The behaviour of SIZ_2 and ADVINT is confusing being positive in some regressions and negative in others. SIZ_2 is however found to be positive and significant in one regression at the .05 level.

Replacing the growth variable GROA figuring in this model by GROS as in model 9.3 improved the overall explanatory power of the model. This can be seen in Table 9.13. The $\bar{R}^2$ and F-values have improved considerably and are higher than those obtained with model 9.2 the results of which were presented in Table 9.12. GROS is now strongly positive and significant in every regression. VI is positive and significant in three regressions. SIZ_2 is positive and significant in two regressions. ADVINT comes off poorly being significant in only one regression that too at the .10 level. The strong showing of GROS indicates that growth in sales has a greater contribution to increasing profitability than growth in assets. Measured in terms of quantitative importance VI is still the most important variable. A 10 percentage point increase in VI increases profitability by upto 2 percentage points. Summing up, it has to be said that although model 9.3 performed better than model 9.2 its explanatory power is still only limited. It thus appears that these variables played only a limited role in determining

the profitability of firms in the pharmaceutical industry.

9.3 CONCLUDING REMARKS

The results of the multivariate analysis seem to broadly agree with the results of the analysis conducted earlier which can be stated to have been partial in nature. For instance, the importance of diversification as a determinant remains unchanged. It is found to be insignificant. Vertical integration continues to play an important role in determining profitability. However, the multivariate analysis does reveal some differences especially with respect to the size variable. The cross-section analysis had earlier suggested that the relationship between profitability and size was negative especially when size is measured by total assets, although a negative bias was suggested at that time. However, the present analysis shows that size, when considered along with other variables, has a positive relationship with profitability. Size however remains quantitatively insignificant. The time-series analysis conducted earlier had shown a similar kind of positive relationship in a number of individual cases especially when profitability was measured by P_2 and size by SIZ_1. Growth measured by the increase in sales revenue is positive as was also witnessed in individual cases earlier. Here it must be mentioned that growth in sales has a strong showing only when introduced in the model 9.3. Quantitatively, however, it has not been that big

an influence. Advertising intensity continues to be unimportant. Probably advertising by rival producers cancelled the advantages derived by each other. Some firms may have, however, been able to protect their advantage as the time-series analysis showed earlier. On the whole, structural variables with the exception of vertical integration seem to play only a small role in determining profitability, if one were to infer from the low explanatory power of the models. Other factors, chiefly regulation, appear to be the major determinants.

Table 9.1

Simple Correlation Coefficients : Model 9.1

Year 1975

	P_1	SIZ_1	DIV	VI	ADVINT	GROS
P_1	1.000	0.076	-0.112	0.246	0.154	0.322
SIZ_1		1.000	0.485	-0.395	-0.281	-0.072
DIV			1. 000	-0.095	-0.130	-0.323
VI				1.000	0.186	0.143
ADVINT					1.000	-0.093
GROS						1.000

Table 9.2

Simple Correlation Coefficients : Model 9.1

Year 1977

	P_1	SIZ_1	DIV	VI	ADVINT	GROS
P_1	1.000	-0.086	-0.209	0.479	-0.157	0.189
SIZ_1		1.000	0.452	-0.502	-0.262	-0.040
DIV			1.000	-0.340	-0.249	-0.331
VI				1.000	-0.207	0.010
ADVINT					1.000	-0.072
GROS						1.000

Table 9.3

Simple Correlation Coefficients : Model 9.1

Year 1979

	P_1	SIZ_1	DIV	VI	ADVINT	GROS
P_1	1.000	0.014	-0.085	0.252	-0.027	0.250
SIZ_1		1.000	0.426	-0.400	-0.241	-0.051
DIV			1.000	-0.301	-0.245	-0.139
VI				1.000	0.056	0.009
ADVINT					1.000	0.001
GROS						1.000

Table 9.4

Simple Correlation Coefficients : Model 9.1

Year 1981

	P_1	SIZ_1	DIV	VI	ADVINT	GROS
P_1	1.000	0.080	-0.145	0.102	0.091	0.286
SIZ_1		1.000	0.448	-0.428	-0.248	-0.045
DIV			1.000	-0.383	-0.186	-0.159
VI				1.000	0.214	0.138
ADVINT					1.000	-0.022
GROS						1.000

Table 9.5

Simple Correlation Coefficients : Model 9.1

Year 1982

	P_1	SIZ_1	DIV	VI	ADVINT	GROS
P_1	1.000	0.033	0.001	0.615	0.236	0.378
SIZ_1		1.000	0.444	-0.381	-0.229	-0.080
DIV			1.000	-0.294	-0.140	-0.192
VI				1.000	0.237	0.193
ADVINT					1.000	-0.126
GROS						1.000

Table 9.6

Regression Results : Model 9.1

Year	1975 N=30	(a)	1977 N=30	1979 N=31	(a)	1981 N=28	(a)	1982 N=23
Intercept	-0.176 (-1.762)	-0.213 (-2.153)	-0.091 (-1.438)	-0.027 (-0.619)	-0.043 (-0.809)	-0.029 (-0.370)	-0.096 (-1.155)	-0.128 (-3.027)
SIZx10^{-8}	0.016 (1.431)***	0.013 (1.779)**	0.004 (1.111)	0.002 (0.729)	0.001 (0.813)	0.003 (0.938)	0.003 (1.401)***	0.002 (1.580)***
DIV	-0.054 (-0.576)	-0.032 (-0.496)	-0.011 (-0.256)	-0.005 (-0.140)	-0.011 (-0.292)	-0.050 (-0.661)	-0.026 (-0.379)	0.028 (0.900)
VI	0.277 (1.428)***	0.379 (2.219)**	0.251 (2.633)*	0.100 (1.490)***	0.156 (1.822)**	0.051 (0.347)	0.221 (1.534)***	0.264 (3.762)*
ADVINT	0.715 (1.077)	0.601 (1.090)	0.049 (0.146)	-0.024 (-0.074)	0.037 (0.121)	0.347 (0.516)	0.569 (0.912)	0.432 (1.280)
GROS	0.033 (1.448)***	0.033 (1.767)**	0.006 (0.947)	0.005 (1.346)***	0.004 (1.162)	0.005 (1.299)	0.003 (0.943)	0.003 (2.035)**
$\bar{R}^2$	0.072	0.094	0.156	-0.025	0.030	-0.063	-0.029	0.470
F	1.455	1.608	2.080	0.850	1.185	0.677	0.844	4.903*
DW	1.609*	1.603*	1.844*	1.793*	1.677*	1.737*	1.871*	1.247
B-P Statistic	51.405*		14.761	18.381*		21.965*		0.071

(a) - weighted least square estimates ; t-values are presented within parenthesis

* - significant at the .01 level ; ** - significant at the .05 level

*** - significant at the .10 level

Table 9.7

Simple Correlation Coefficients : Model 9.2

Year 1975

	P_2	SIZ_2	DIV	VI	ADVINT	GROA
P_2	1.000	-0.024	-0.084	0.187	0.085	0.261
SIZ_2		1.000	0.500	-0.348	-0.377	0.007
DIV			1.000	-0.095	-0.130	-0.323
VI				1.000	0.186	-0.216
ADVINT					1.000	-0.254
GROA						1.000

Table 9.8

Simple Correlation Coefficients : Model 9.2

Year 1977

	P_2	SIZ_2	DIV	VI	ADVINT	GROA
P_2	1.000	0.054	-0.201	0.269	-0.108	0.031
SIZ_2		1.000	0.435	-0.386	-0.369	-0.048
DIV			1.000	-0.340	-0.249	-0.349
VI				1.000	-0.207	-0.028
ADVINT					1.000	-0.029
GROA						1.000

Table 9.9

Simple Correlation Coefficients: Model 9.2

Year 1979

	P_2	SIZ_2	DIV	VI	ADVINT	GROA
P_2	1.000	-0.063	-0.047	0.182	-0.131	0.013
SIZ_2		1.000	0.390	-0.293	-0.353	-0.053
DIV			1.000	-0.312	-0.264	-0.123
VI				1.000	0.053	0.005
ADVINT					1.000	0.051
GROA						1.000

Table 9.10

Simple Correlation Coefficients: Model 9.2
Year 1981

	P_2	SIZ_2	DIV	VI	ADVINT	GROA
P_2	1.000	-0.204	-0.187	0.171	0.054	0.142
SIZ_2		1.000	0.414	-0.328	-0.410	0.069
DIV			1.000	-0.383	-0.186	-0.096
VI				1.000	0.214	0.018
ADVINT					1.000	-0.055
GROA						1.000

Table 9.11

Simple Correlation Coefficients : Model 9.2

Year 1982

	P_2	SIZ_2	DIV	VI	ADVINT	GROA
P_2	1.000	0.177	-0.171	0.523	0.136	0.394
SIZ_2		1.000	0.390	-0.236	-0.304	0.029
DIV			1.000	-0.294	-0.140	-0.102
VI				1.000	0.237	0.080
ADVINT					1.000	-0.062
GROA						1.000

Table 9.12

Regression Results : Model 9.2

Year	1975 N=30	(a)	1977 N=30	1979 N=31	1981 N=28	1982 N=23
Intercept	-0.051 (-0.641)	-0.147 (-1.401)	0.040 (0.512)	0.081 (1.683)	0.087 (1.803)	-0.036 (-0.817)
$SIZ_2 \times 10^{-8}$	0.007 (0.515)	0.018 (1.285)	0.010 (1.071)	-0.002 (-0.308)	-0.003 (-0.690)	0.008 (1.946)**
DIV	0.006 (0.101)	-0.005 (-0.077)	-0.053 (-0.941)	-0.002 (-0.048)	-0.014 (-0.317)	-0.023 (-0.587)
VI	0.185 (1.375)***	0.332 (1.877)**	0.140 (1.209)	0.059 (0.799)	0.036 (0.412)	0.244 (2.847)*
ADVINT	0.426 (0.849)	0.807 (1.269)	-0.018 (-0.042)	-0.311 (-0.801)	-0.079 (-0.183)	0.319 (0.733)
GROA	0.032 (1.750)**	0.043 (1.930)**	-0.001 (-0.129)	0.0004 (0.083)	0.002 (0.688)	0.003 (1.967)**
$\bar{R}^2$	-0.014	0.066	-0.041	-0.130	-0.125	0.365
F	0.919	1.415	0.768	0.307	0.397	3.539**
DW	1.949*	1.955*	2.102*	1.632*	1.527	1.361
B-P Statistic	23.698*		13.105	14.037	12.217	7.125

(a) - weighted least square estimates ; t-values are presented within parenthesis

* - significant at the .01 level ; ** - significant at the .05 level

*** - significant at the .10 level

Table 9.13

Regression Results : Model 9.3

Year	1975 N=30	(a)	1977 N=30	1979 N=31	1981 N=28	1982 N=23
Intercept	-0.023 (-0.343)	- .140 (-1.630)	-0.014 (-0.191)	0.052 (1.112)	0.068 (1.622)	-0.040 (-0.926)
$SIZ_2 x10^{-8}$	0.005 (0.391)	0.025 (2.031)**	0.010 (1.138)	-0.002 (-0.332)	-0.002 (-0.646)	0.008 (1.865)**
DIV	0.017 (0.272)	-0.019 (-0.323)	-0.020 (-0.382)	0.008 (0.188)	-0.006 (-0.168)	-0.015 (-0.385)
VI	0.083 (0.662)	0.230 (1.575)***	0.170 (1.538)***	0.062 (0.899)	0.017 (0.229)	0.220 (2.590)*
ADVINT	0.355 (0.772)	0.906 (1.615)***	0.116 (0.273)	-0.293 (-0.801)	-0.013 (-0.036)	0.412 (0.957)
GROS	0.038 (2.547)*	0.055 (3.431)*	0.011 (1.418)***	0.008 (1.776)**	0.006 (2.756)*	0.004 (2.213)**
$\bar{R}^2$	0.099	0.276	0.038	-0.004	0.145	0.395
F	1.643	3.219*	1.230	0.975	1.918	3.880*
DW	1.673*	1.702*	1.987*	1.327	1.042	1.500
B-P Statistic	32.512*		10.140	5.131	4.627	9.333

(a) - weighted least square estimates ; t-values are presented within parenthesis

* - significant at the .01 level ; ** - significant at the .05 level

*** - significant at the .10 level

CHAPTER 10

SUMMARY AND CONCLUSIONS

10.1 RECAPITULATION

In the introductory chapter we had noted the salient features of the Indian pharmaceutical industry. To begin with, we noted the existence of a wide variety of firm sizes. It was mentioned that competition in the industry took non-price forms and as a consequence the firms in the industry were highly advertising intensive. Further it was stated that several changes had occurred in the structure of pharmaceutical firms many of whom were now diversified and vertically integrated. Another prominent feature that was noted was the presence of strict controls over pharmaceutical product prices and also over the profitability from their sale.

With this as the background the following questions were raised :

(a) How important were the structural features of the firms belonging to the industry in determining their profitability?

(b) What was the effect of changes in particular structural features on profitability?

(c) What was the relative importance of price controls vis-a-vis structure in determining the profitability of pharmaceutical firms?

The objective of the study was to carry out an indepth analysis to answer these questions.

It was seen that a few studies had attempted to study these aspects but they remained largely incomplete as they had focussed on only one or two determinants. It was thus our endeavour to consider a larger number of factors and to undertake a detailed investigation so that these questions may be answered comprehensively. We thus took into account five important firm-level determinants of profitability which were size, degree of diversification, degree of vertical integration, advertising intensity and growth of the firm. In addition, the prices of drugs and pharmaceuticals were also considered. A regression framework using the ordinary least squares method of estimation was adopted as the method of analysis with checks being carried out at various stages for model violations such as autocorrelation, heteroscedasticity and multicollinearity.

The early part of the study was devoted to an indepth examination of the relationship between alternate measures of profitability and each of the determinants through simple hypothesis such as the profitability of a firm is a function of its size, profitability is a function of the degree of diversification and so on. The simple two variable regression models were used in this part of the study. The

emphasis in the early part was on time-series analysis so as to examine the effect of changes in each element considered on profitability. This was followed by a preliminary cross-section analysis. Later in the study a full model was postulated in which the determinants of profitability were size, degree of diversification, degree of vertical integration, advertising intensity and growth experienced by the firm. Prices of pharmaceutical products were not considered for inclusion in the full model as they were measured by price indices which were common to all firms.

The preliminary results of the study are summarized as follows :

(a) No consistent relationship could be detected between profitability and size. Although size as an explanatory variable was found to be significant in the case of a number of firms by the time-series analysis the relationship took different functional forms in individual cases. The functional form of the relationship could be linear, semi-logarithmic or curvilinear which differed from case to case. Thus, the relationship between profitability and size when studied with cross-section data refused to conform to any of the three specifications mentioned above. The time-series analysis also showed that the functional form of the relationship was liable to change as one used different measures of profitability and size.

(b) The cross-section analysis showed that, in general, the degree of diversification was not a significant determinant of firm-level profitability. The relationship proved to be weakly negative. The time-series analysis, however, found diversification to be a significant determinant in certain individual cases. This analysis showed that in these cases the extent to which diversification acted as a determinant of profitability depended not on how well-diversified the firm was but on how successful it was in its diversified undertakings. If the firm met with success when it undertook new lines of production its overall profitability improved, if not its profitability declined. In most cases, however, diversification was not found to have any significant effect on profitability and was thus inferred to have been undertaken for purely defensive reasons only.

(c) The degree of vertical integration was found to be an important determinant of firm-level profitability. The cross-section analysis found the two to be strongly related, positively. The time-series analysis confirmed, this finding. However, subsequent analysis threw up the possibility of overestimation of the relationship. This was especially the case with the analysis using regression model 5.1. The time-series data on the value-added to sales ratio, which was the measure of vertical integration used, was seen to have experienced a decrease over the time-period. The strong

positive relationship shown up by model 5.1 was thus accounted for by the fact that the profitability on sales had also declined. The decline in the value-added to sales ratio was not taken to indicate that firms had disintegrated. Rather it was taken to imply that the extent of vertically integrated production had not increased significantly as was expected. It was felt that in the short run the firms might have preferred to purchase the inputs necessary for the increasing production from the market rather than organize their manufacture within the firm. The firms it was felt may have done this for the following reasons. Firstly, to quickly tap a growing market. Secondly, 'Government fixed' rates of return in bulk drug production may have proved inadequate and acted as a disincentive for fresh investment in manufacturing facilities to produce all the required basic drugs. Thirdly, the size of the market itself may not have warranted this investment.

The time-series analysis also showed that the profitability on assets may not have been as seriously affected by the declining levels of integration as was the profitability on sales. In some cases profitability on assets was seen even to have increased.

(d) No statistically significant relationship could be detected between profitability and advertising intensity by the cross-section analysis. It could, therefore, be said

that, in general, there existed no evidence of any anticompetitive effects to advertising. It is possible that price controls prevented the use of market power gained by firms from advertising to price in a monopolistic manner and increase their profit margins.

The time-series analysis showed that a few firms might have managed to increase their profit margins more likely due to a decrease in the average cost of advertising resulting from decreasing advertising intensity. This was made possible by increasing returns to advertising expenditure. The success in shifting demand adequately had helped in maintaining or even increasing the profitability on assets in some cases even though the corresponding profit margins had declined.

(e) The cross-section analysis could not detect a statistically significant relationship between profitability and growth in either the demand or the supply sides. This pointed to the possibility that the relationship might vary a great deal between firms and was shown to be true by the time-series analysis. The analysis showed that there existed a positive significant relationship between profitability and growth both on the supply and demand sides in some cases while the relationship in the case of other firms was mainly insignificant. This situation may be called a 'win' or a 'no-loss' situation with growth not having any detrimental effect on profitability.

(f) Government price controls proved to be an important determinant of profitability. The analysis showed that in many cases profitability on sales turnover had declined inspite of an increase in the selling prices of drugs and pharmaceuticals. Subsequently it was seen that the increase in selling prices might not have fully compensated the increase in the cost of inputs, thus affecting the profit margins. While this was generally true, there were particular instances where profitability on sales remained unaffected probably indicating that the increase in selling prices granted by the Government might have proved adequate to cover the increase in production cost in these cases. It was also noticed that while profitability on sales might have been adversely affected this was not always the case with the rate of return on assets. By shifting demand adequately some of the firms had been able to compensate decreasing profit margins. This allowed them to maintain or even increase the size of their absolute profits so that the return on assets was either unchanged or even registered a small increase.

These were the results of the preliminary analysis using simple models. The results obtained with the full model seem to broadly agree with the preliminary results. Size was found to be quantitatively unimportant as a determinant of profitability. The degree of diversification and advertising

intensity also turned out to be statistically insignificant. The degree of vertical integration appeared to be the most significant determinant of profitability. Growth in sales, i.e., the demand side, was found to be statistically significant in some regressions but was not very important quantitatively.

The main conclusion that emerges from the study is that firm-level determinants, in general, with the exception of vertical integration, play only a small role in determining profitability. This condition can be traced to the presence of price controls. Price controls while becoming important determinants of profitability themselves, have relegated other firm-level determinants to the background. Given unfavourable external constraints the only course available to pharmaceutical firms seems to be to go in for a greater degree of vertical integration to improve efficiency and thereby cut production costs which would then help them in preserving their profit margins. But, here the ceilings imposed on profitability may act as a disincentive. In the short run the strategy adopted by the firms was to either diversify for defensive reasons or to aggressively shift demand which enabled them to preserve and in some cases even increase the size of their profits. But in the long run as competition increases internalization may be the only course open to sustain profitability given the continuity of unfavourable external circumstances.

As far as Government policy is concerned we have seen that price controls have progressed to an extent where they have subdued competition and in the long run it would prove harmful to the cause of efficient production by allowing a high cost industry to develop which would defeat the very purpose of price controls. In addition, decreasing profitability resulting from price controls would restrict the availability of internal funds which are very essential for growth. This is detrimental to the governmental objective of self-sufficiency in drug production. It is already evident that unfavourable prices have turned many companies' away from the manufacture of essential drugs thus increasing dependence on imports. What is required is a scaling down if not complete elimination of price and profit controls thus allowing firm-level determinants a greater say in determining prices and profitability. This would lead to greater efficiency in organizing production, the benefits of which would then be available to the consumer.

10.2 SUGGESTIONS FOR FURTHER RESEARCH

In this study we considered only some important firm-level determinants because of data constraints. One of the most important variables that had been omitted was R and D intensity. This was done on two grounds, namely (a) R and D expenses being only a small part of the firms' total expenditure

and (b) lack of sufficient data. However, in recent years attitudes towards the importance of R and D have been changing primarily because of new incentives, Government goading and to a little extent due to increasing competition. The availability of data has also improved. The inclusion of this variable may now be worthwhile in any extension of this study.

Another area where improvements are necessary is in the measurement of vertical integration. The ratio used in this study to capture vertical integration, as one is aware, does not reflect it accurately. Efforts have already been made in the literature to improve the measure of vertical integration at the industry-level using ratios based on 'use' and 'make' matrices. Such measures are however unavailable at the firm-level. The use of better measures of vertical integration as and when they become available is sure to yield better results.

The sample used in this study also offers enough scope for improvement. The sample had to be continuously pruned in different parts of this study because of inadequate reporting. Of late, with companies taking a healthier attitude to reporting it has become possible to enlarge the sample size to make the study more representative.

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